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EDITORIAL

With this issue of *Kalmiopsis* I've decided to focus attention on the eastern two-thirds of the Beaver State. The exception is Ms. Ertter's article on western botanical history. All the articles are, I believe, especially well researched.

The chosen Plant of the Year, the western juniper, is a departure for three reasons: first, it is a tree, which we haven't yet done; second, as an experiment, photographs rather than drawings are used to illustrate it; third, it is not rare. But, it is a major player in the various debates over the management of Oregon's arid lands. Debates which may become moot. Now that Congress has passed the logging-without-laws bill, the wholesale transfer of our nation's resources to the corporations is in full swing. Its impact will be acutely felt all over Oregon. The proposed solution to our ailing eastside forests, for example, is, as expected, more logging. Only you can prevent forest fire sales.

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COVER PHOTO

Statue, root harvest. Warm Springs Tribal Council Building. Photograph by Richard Ettinger.

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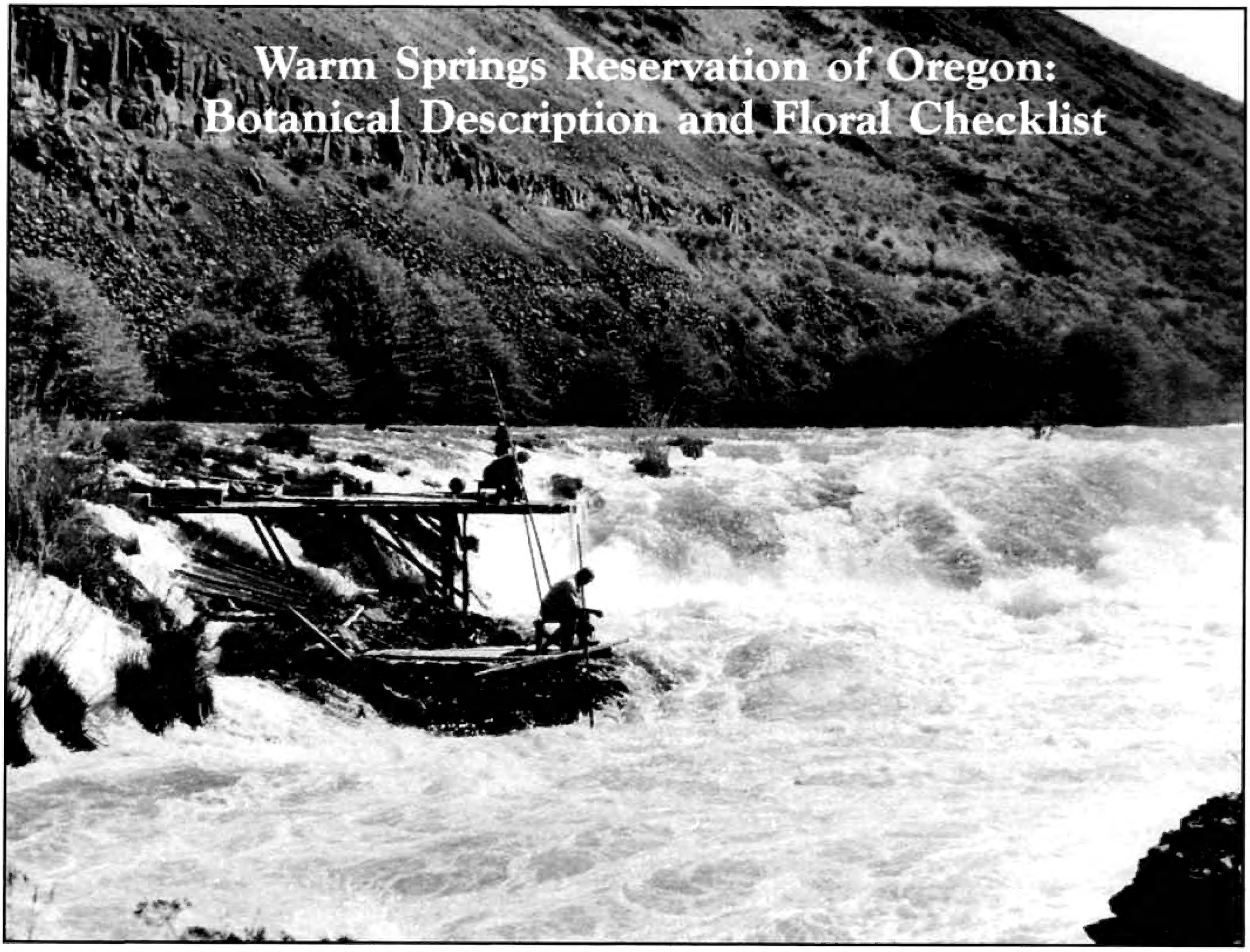
Warm Springs Reservation of Oregon: Botanical Description and Floral Checklist



OREGON STATE HIGHWAY PHOTO 7173; COURTESY DESCHUTES COUNTY HISTORICAL SOCIETY

Warm Springs Reservation, from the Deschutes River, ca. 1930s. Indians fishing near Maupin, OR. in Wasco County, in the traditional manner.

By MARJORIE L. ETTINGER and SUSAN E. HARLESS

Physiographic Description

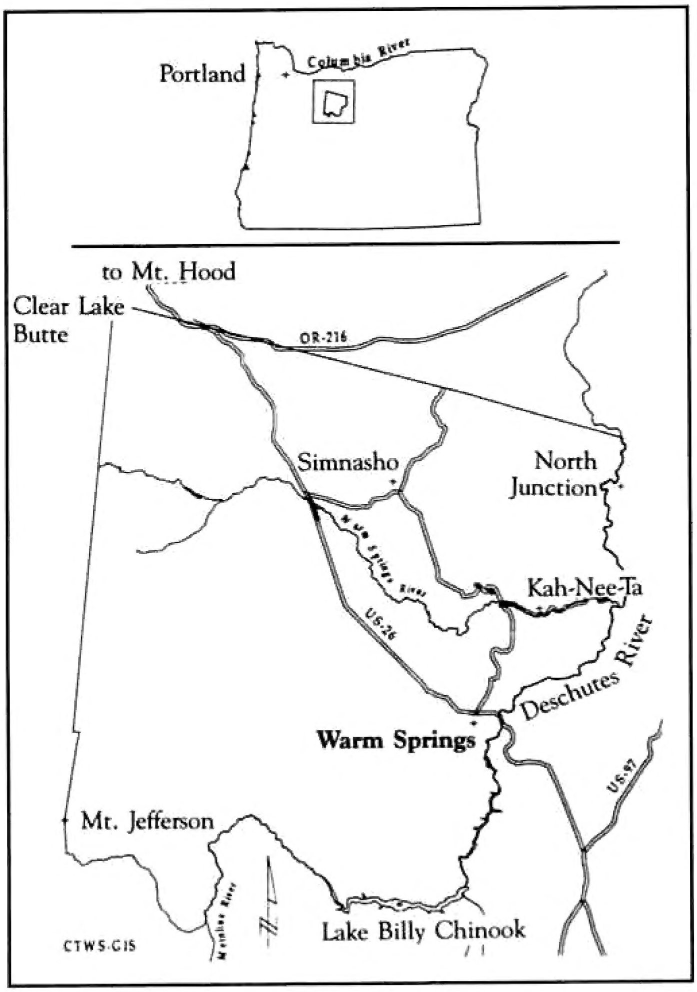
The Warm Springs Reservation of Oregon blankets the eastern slope of the Cascade Divide from just south of Mt. Hood to the south shoulder of Mt. Jefferson. It reaches to the deep, basalt-rimmed canyons of the Deschutes and Metolius canyons on the east and south, and encompasses over 640,000 acres of snow-capped mountain, forest, high desert and river canyon country. The largest Reservation in Oregon, it is bigger than the entire state of Rhode Island. Its elevation ranges from 10,497 feet at the summit of Mt. Jefferson, to 1,000 feet along the Deschutes River Canyon at the northeastern corner of the Reservation. The major portion of the Reservation is located in Jefferson and Wasco counties, although fragments are in Clackamas (the headwaters of the Clackamas River) and Marion counties (Breitenbush Lake).

The Reservation has had only limited access for non-Indians since its creation by treaty with the Middle Oregon Indians in 1855. Two bands of inland Native cultures, the Warm Springs (Sahaptin) and the Wasco (Chinookan), were settled on the Reservation in 1859. A third band from eastern Oregon, the Northern Paiute (a Great Basin culture), joined them in 1879. These three bands are now known collectively as the Confederated Tribes of the Warm Springs Reservation of Oregon.

In 1972, the Reservation's western and northern boundaries were greatly adjusted during a re-survey of the boundaries, correcting a significant deviation from the original treaty description of the lands. This reconfiguration now incorporates the lands known as the McQuinn Strip.

Reservation lands are accessible from only two highways; US Highway 26 (completed in 1948) transects the Reservation northwest to southeast to Madras, and State Highway 126 follows along its northern border to Maupin. A paved road from Highway 126 traverses the Reservation through Simnasho and the resort community of Kah-Nee-Ta to the settlement at Warm Springs.

The Reservation has been kept intact since the original treaty, and has remained largely undeveloped, with the exception of some logging and limited cattle and wheat ranching



Warm Springs Reservation of Oregon.

activities. The flora is therefore generally undisturbed by commerce, cattle or cars, and provides a unique glimpse into the evolution and natural history of a semi-arid region in the absence of culturally induced fires. It was this pristine botanical condition that interested the Ettingers.

Human Pre-History

During the historic period, no documented tribes or bands of Native Americans had permanent encampments on the Reservation lands. However, there were numerous sites of intermittent, semi-permanent seasonal usage of land and the botanical, riverine and faunal resources. The nearest known continuously occupied area was just to the north of the Reservation at Celilo Falls, near present-day The Dalles.

Archeological investigations undertaken in conjunction with construction on the Reservation have recently been conducted at several important sites that have been radiocarbon dated to more than 9,000 years b.p. (before present). Indications are that previous indigenous populations were also of Plateau Culture heritage with basketry, woven mats, and similar artifacts well represented. Subsistence was primarily dependent on seasonal rounds during which fish, roots, seeds and berries, all available in abundance on Reservation lands, were harvested in turn.

Reports from the earliest Euro-American explorations along the Columbia River, the Lewis and Clark Expedition of 1804-06 which passed eighty miles to the north, describe The Dalles as an important trading center for all Western tribes and cultures. The primary access to The Dalles from the south and east was via an Indian trail along the Deschutes River canyon bordering the current eastern Reservation boundary.

Early Botanical Exploration of the Reservation

Records of the natural resources, specifically the botanical bounty of the Reservation lands, are scarce. The earliest botanical explorations of these lands were restricted by seasonal and access constraints.

In December 1825, Peter Skeen Ogden, Finian McDonald and Thomas McKay, trappers from the Hudson's Bay Company out of Fort Vancouver, passed through the Reservation, making few notes on the botany of the area due to the winter season. Late in the fall of 1834, and once more in the winter of 1843, Nathaniel J. Wyeth traveled through the area. Again, no significant journal entries pertain to the botany of the area from his expeditions.

John Strong Newberry, M.D., a physician/botanist/geologist with the Pacific Railroad Survey party under the direction of Lts. R.S. Williamson and Henry L. Abbott came through the Deschutes and Metolius canyons in September and October 1855. Newberry was the only trained botanist to leave written records of his travels, but he did not cross Reservation lands, travelling only along the Indian trail that follows its eastern boundary. In the introduction to his "Botanical Report of the Route," he stated that his intention was to study the botany of the region "to discern those phenomena which have controlled the radiation of species from their original centers of creation." This statement was published four years before Darwin's *Origin of the Species*.

Other early European and American botanists such as David Douglas, Thomas Jefferson Howell, Thomas Nuttall, William Canby, Edward Greene, and William Cusick have left no reports of travels to or plants acquired from Reservation lands.

In 1949, Drs. David and Kathrine French, anthropologists and ethnobotanists from Reed College in Portland, kindled scientific interest in the natural resources of the Reservation. They spent two summers and multiple subsequent visits studying the cultural elements, linguistics, and ethnobotany of the tribes residing on the Reservation, focusing primarily on the Wascos. Their studies concentrated on the cultural plant areas of the Reservation, and did not extend into the remote areas. A significant private herbarium and an unpublished manuscript on the ethnobotanical and medicinal plants of the Reservation resulted. Several papers citing notable plants, range extensions, and cultural uses of plants were also published as a result of studies supervised by Dr. David French (see References).

In the mid-1980s further studies of the plant associations and ecological domains of the Reservation were undertaken by employees of the Bureau of Indian Affairs and the tribal Department of Forestry. These investigations resulted in a 600+

specimen vascular plant herbarium that was created by Frank Marsh, Richard Helliwell, Jean Rodgers and Rick Krause of the Warm Springs Department of Forestry.

Informal botanical studies and photography were begun in 1979 by Marjorie and Richard Ettinger and have continued intermittently until 1995. With annual letters of permission from the Tribal Council, the Ettingers have collected in many previously inaccessible remote and mountainous areas of the Reservation, often traveling by horseback, on foot, or by four-wheel drive vehicle.

Geology of the Reservation

A significant portion of north central Oregon has been labeled the Deschutes-Umatilla Plateau, and a large portion of these high lava plains created by the Columbia flood basalts, dating from 4-16 my (million years ago), comprise the surface geography of the Warm Springs Reservation.

RICHARD ETTINGER

Current photo of Deschutes River shows greatly increased vegetation, primaily juniper and sage, probably resulting from the decrease in fires on the Reservation in the past 140 years.

On the western shoulder of the Reservation is the spectacular barrier of the High Cascades, created within the past few million years. Along this portion of the Reservation, andesitic lava flows and associated ash flows overlay much older layers of lava which flooded this area during the Miocene epoch about 16 my. Heavily glaciated features are visible on these slopes.

The plateau of Columbia flood basalts is deeply dissected by several major rivers and many smaller tributaries: the Deschutes, the Metolius, Warm Springs, and White Water Rivers, and Mill and Boulder Creeks.

Outcrops of even older ash flows, called the John Day Formation (20-35 my) and the Clarno Formation (35-50 my), have also been identified. These often appear as deep layers of light-colored pumice or as orangish prominences of welded tuff, best observed in the eastern portion and Mutton Mountains of the Reservation.

The high lave cap, seen best when entering the Reservation from the south, originated from Tetherow and Round Buttes north of Redmond about five million years ago. More recent events, such as the Newberry lava flows from the south or the floods from Glacial Lake Missoula to the north had little or no effect on the geology of Warm Springs.

Soils and Habitats

Rainfall on the Reservation varies widely. Along the Cascade crest, there is plentiful snow and water from permanent snowfields and glaciers of Mt. Jefferson and other Cascade slopes. Thirty-six miles to the east, along the banks of the Deschutes River, rainfall drops to an average of less than 10 inches annually. Not only are there severe climatic conditions related to rainfall, but the generally great elevation range (1,000 feet to over 10,000 feet) combines to create a variety of habitats.

There are several major habitats that accommodate a wide variety of plants. The major communities can be described as: rocky scabland with grasses and herbs dominating; sagebrush steppe, juniper *(Juniperus sp.)* forests, generally indicating deeper soils; pine *(Pinus sp.)* forests, indicating more rainfall; Douglas fir-mountain hemlock, *(Pseudotsuga menziesii* and *Tsuga mertensiana)* closer to the mountains and higher in elevation; subalpine fir *(Abies lasiocarpus)*; whitebark pine *(Pinus albicaulis)*; and alpine, generally above 6,000 feet in elevation. Several white oak groves *(Quercus garryana)* are scattered along the fringes of the Mutton Mountains in the northeastern portion of the Reservation. Richard Helliwell (1991) described the botanical associations in these forested areas.

Along the rivers, streams and lakes at all altitudes are luxurious meadows and riparian habitats. The older John Day derived soils in the eastern portion of the Reservation degrade to heavy clay. There are also intermittent accumulations of glacial till and gravel and some clay stream banks. Otherwise the soil is a generally thin, sandy-pumice or sandy-loam volcanic tephra.

Reservation soils were surveyed by contract with Weyerhauser scientists in 1980, resulting in a privately published document describing the soil resources of the entire Reservation (Jenkins: 1981).

Paleobotany

(*Most fossil flora identifications from the Warm Springs area have been done by Melvin Ashwill of Madras, with assistance from Steven Manchester, paleobotanist from the University of Florida, and from Gaylord Brooks on fossil woods, from Boring, Oregon. Ted Fremd, vertebrate paleontologist from the John Day Fossil Beds National Monument, John Day, Oregon, identified fossil animal remains and assisted with dating some fossiliferous flora.)

The moist subtropical environment of the Eocene in this region gradually gave way to the harsher, semi-arid climate seen on the Reservation today. Due in part to global climatic conditions, this change also reflects the growing influence of the Cascade Range and its increasingly significant rain shadow over the last 25 million years.

The oldest known fossil floras on the Warm Springs Reservation date to the Oligocene, est. 32 my, from a climate that was moist, warm and temperate in nature. Exposed fossil beds in the Whitehorse Rapids Flora from the lower John Day Formation include pine *(Pinus sp.)*, Chinese fir *(Cunninghamia sp.)*, dawn redwood *(Metasequoia sp.)*, chestnut *(Castanea sp.)*, white oak *(Quercus sp.)*, alder *(Alnus sp.)*, sweet fern *(Comptonia sp.)*, walnut *(Juglans sp.)*, and willow *(Salix sp.)*.

The Health Ranch Fossil flora are from the Upper John Day Formation and are estimated to be 22-23 my. They describe a more temperate climate. Significant additions to the paleobotanical list from this site include the oldest Reservation findings of maple *(Acer sp.)*, Oregon grape *(Berberis sp.)*, and huckleberry or rhododendron *(Ericaceae)*. Maple *(Acer sp.)* and several unidentified leaves are also found at the nearby Horse Trap Flora from the Miocene, 18 my, in the uppermost John Day Formation.

The Foreman Point Flora from the Miocene era, 15 my, comes from the Simtustus Formation along the north flank of the Mutton Mountains and indicates a significantly drier, cooler condition. Such diverse specimens as horsetail *(Equisetum sp.)*, maiden hair tree *(Gingko sp.)*, as well as avocado genus *(Persea sp.)* and moonseed *(Cocculus sp.)* are found in addition to those previously listed.

The Dry Hollow Flora, from near the Deschutes River along the Jackson Trail, and the Kah-Nee-Ta Flora, from below the rimrocks above Kah-Nee-Ta Lodge, are from the Deschutes Formation and are about 6 my. These floras are from the Miocene and include pines *(Pinus sp.)*, with associated cone impressions and log molds, cedar *(Thuja sp.)*, and Oregon grape *(Mahonia sp.)*.

The Deschutes Flora, located about a mile east of the Reservation on the Warm Springs grade, dates from 5.3 my, and includes willows *(Salix sp.)*, cottonwoods *(Populus sp.)*, and box elders *(Acer sp.)* in a condition nearing modern semiaridity. According to Ashwill, oak *(Quercus sp.)* is one of the most persistent fossil plants found on the Reservation.

Economic Botany

Traditionally, Native cultures have embraced the obligation to care for their natural resources. The Warm Springs tribes used the native roots, fish, berries and game for food, as well as plants for technological and medicinal uses without visible detrimental impact. Fire may have also been used selectively, especially to insure a plentiful huckleberry *(Vaccinium sp.)* harvest, and these fields were vigorously tended, burned and replanted. Horses grazed freely on native grasses.

Under an earlier Reservation protocol, agricultural crops and cattle ranching were encouraged. Agriculture agents from Oregon State University arrived on site to give the Indians advice and encouragement in these pursuits. A small canal was built to irrigate a suitable area and family gardens were promoted. Due to the small population, however, these practices never had much permanent impact on the overall natural habitat. However, cattle grazing did denude some slopes of the native flora, especially along the Deschutes River.

Today, these agricultural efforts have been mostly abandoned. The resulting effects have been the introduction of weedy species — cheatgrass *(Bromus tectorum)*, mustards *(Cruciferae)*, chenopods *(Chenopodiaceae)*, and mullein *(Verbascum sp.)*. There are also many introduced species, such as crested wheat *(Agropyron sp.)*.

Timber harvesting has increased in the last fifty years, with heavy cutting during the 1980's. Heavily logged areas are small and scattered, and today they support the greatest diversity of herbaceous growth. An increasingly sophisticated forest management program now concentrates on eradicating unnecessary timber harvesting roads to allow for greater growth potential.

Lightening and human caused firest periodically sweep quickly through portions of the Reservation, destroying mostly grasses, junipers, and sagebrush. A huge fire in 1994 ravaged over one-third of the eastern portion of the Reservation, finally stopping on the western bank of the Deschutes River.

The Forestry Department, under the auspices of the Bureau of Indian Affairs on the Reservation, has been systematically mapping the Reservation's natural resources, including both its economic and cultural botany, through the Geographical Information System (GIS).

Ethnobotany

Columbia River and Plateau peoples have used the Reservation lands for millennia, resulting in intensification of plant growth in some cultural plant areas. The most significant cultural plants are used for food, ceremonies, medicines and utilitarian items.


RICHARD ETTINGER

Lomatium cous. *Known as "kous" by the Indians, it is one of the first roots to be harvested, and is honored annually at the Root Festival ceremony when thanks is offered for abundant food.*

Eugene Hunn notes at least twenty-five species that are frequently dug for food. Edible underground plant parts include various tubers, corms, bulbs, roots, and underground sprouts. Root food species are primarily biscuitroot *(Lomatium sp.)*, bitterroot *(Lewisia rediviva)*, camas *(Camassia sp.)*, balsamroot (primarily as an emergency food) *(Balsamorhiza sp.)*, and Indian carrot or yampah *(Perideridia gairdneri)*. Not all are found in harvestable quantities on the Reservation.

Plants picked for food include currant *(Ribes sp.)*, huckleberries and blueberries *(Vaccinium sp.)*, chokecherries *(Prunus*

virginiana), salal (Gaultheria sp.) and serviceberries (Amelanchier alnifolia). Lichens (Alectoria fremontii) were gathered, particularly from the Mutton Mountains, and pit-baked as a delicacy or "Indian pudding." Acorns were gathered from the Garry Oak (Quercus garryana). Most roots, seeds, and fruits were gathered and eaten in season. Any excess was dried for use throughout the year or saved for times of drought or need. Despite centuries of use, these resources have apparently not declined in availability.

RICHARD ETTINGER

Camassia quamash. Favored root food of Plateau Indians.

Indian hemp *(Apocynum cannabis)*, tule or bullrush *(Scirpus acutus)*, willow *(Salix sp.)*, and cattail *(Typha latifolia)* were important for household items, basketry and mats. Juniper *(Juniperus sp.)* was used for weaponry, and mountain mahogany *(Cercocarpus ledifolius)* was heat-treated and hardened for use as root digging sticks. Other important utilitarian plants include lichens *(Letharia vulpina)* for tanning and coloring hides, fir branches *(Abies sp.)* for sweat houses and wild roses *(Rosa sp.)* for purification and cleansing.

Kathrine French states that medicinal plants were primarily used according to individual family recipes passed down through oral tradition, in contrast to having a cultural pharmacopeia, in which medicines would be generally used throughout the cultures by many people for the same ailments.

Medicinal, ceremonial, sacred and spiritual uses for plants are not frequently discussed by the Native Americans on the Reservation. For more information regarding plants generally used by Chinookan and Sahaptin peoples for these purposes, see Eugene Hunn (1990).

Botany of the Reservation

A botanical checklist of over 1000 identified varieties has been compiled from all the known collections of Warm Springs plants. The list reflects a varied and stable habitat, with wide diversity due to the broad range of geographical and climatic conditions. It also includes many plants introduced by farming and grazing conditions that are found only in disturbed areas. The following discussion will be only of the plants deemed most interesting and important. All other plants found were considered typical of the eastern Cascade habitats.

Sensitive Species

Eighteen plants found on the Reservation are listed on Oregon's Rare, Threatened or Endangered list published in 1989. Without regard to special status, these plants are: Douglas' onion *(Allium douglassii var. nevii)*, rock onion *(Allium macrum)*, Cascade rockcress *(Arabis furcata)*, Gorman's aster *(Aster gormanii)*, long-bearded sego lily *(Calochortus longebarbatus var. longebarbatus)*, pond sedge *(Carex microptera [C. limnophila])*[1], John Day chaenactis *(Chaenactis nevii)*, alpine collomia *(Collomia larseni [C. debilis])*, mountain lady-slipper *(Cypripedium montanum)*, Cascade daisy *(Erigeron cascadensis)*, gnome-plant *(Hemitomes congestum)*, Baker's linanthus *(Linanthus bolanderi [L. bakeri])*, Hamblen's Coeur d'Alene lomatium *(Lomatium farinosum var. hambleniae)*, French's lomatium *(Lomatium frenchii [L. watsoni])*, clubmoss *(Lycopodium annotinum)*, Peck's penstemon *(Penstemon peckii)*, Klamath gooseberry *(Ribes inerme var. klamathense [R. kalamathense])*, and scapose silene *(Silene scaposa var. scaposa)*.

Of these, three species found are well outside of their normal range: Coeur d'Alene lomatium is found in eastern Washington and neighboring Idaho. Scapose silene normally inhabits the Blue Mountains of eastern Oregon. John Day chaenactis has long been considered an endemic of the John Day area over fifty miles to the east.

RICHARD ETTINGER

Lomatium frenchii

Four sensitive species are considered to be range extensions beyond that listed in Hitchcock and Cronquist: Douglas' onion is found south of its described range, rock onion is found west, Cascade daisy is normally found in the western Cascades, and Peck's penstemon is found north of its listed range.

Unusual Plants

Two plants on the Warm Springs Reservation are of ongoing taxonomic interest. *Lomatium frenchii* is found in a concentrated area of desert scabland, geographically isolated from *Lomatium watsonii* populations in northern Wasco county. This plant was previously described by Mathias and Lincoln Constance in 1959. Hitchcock and Cronquist declined the new species name; however, descriptively this plant continues to be significantly different from *L. watsonii*. Molecular and taxonomic studies of these two species are being pursued at Washington State University.

[1]Bracketed names are found in Hitchcock and Cronquist.

Penstemon fruticosus (potential new variety)

A flourishing population of *Penstemon fruticosus* with small serrated leaves and large corollas is also of continuing interest. This isolated variety flourishes in an unusual desert rock outcropping near Kah-Nee-Ta resort. It also is undergoing molecular and taxonomic studies at WSU and Ohio State University.

The following is a listing of plants from the Reservation considered to be significantly out of range, or notable range extensions.

Out of Range Plants	Normal Range
Allium pleianthum (many-flowered onion)	Wheeler County
Angelica canbyi (Canby's angelica)	Ochoco Mountains
Aster adscendens (long-leaved aster)	Blue Mountains
Camassia leichtlinii (Leichtlin's camas)	Willamette Valley
Cardamine pulcherrima var. *pulcherrima* (slender toothwort)	Olympic peninsula
Corallorhiza trifida (early coralroot)	Wallowa County
Downingia yina (spreading downingia)	Lake County
Eriophyllum lanatum var. *achillioides* (woolly sunflower)	Willamette Valley
Eryngium alismifolium (coyote thistle)	Harney County
Frageria virginiana var. *glauca* (wild strawberry)	Rocky Mountains

Out of Range Plants	Normal range
Grindelia nana var. *nana* (low gumweed)	Idaho
Lomatium nevadense (Nevada desert parsley)	Great Basin
Lomatium utriculatum (common lomatium)	West Cascades
Lupinus polyphyllus var. *pallidipes* (bigleaf lupine)	Willamette Valley
Madia sativa (coast tarweed)	West Cascades
Microseris borealis (apargidium)	Pacific coast
Rubus idaeus (red raspberry)	Idaho
Rubus nigerrimus (northwest raspberry)	Snake River
Senecio macounii (Puget butterweed)	West Cascades
Vancouveria hexandra (inside-out flower)	West Cascades

Range Extensions	Extended to the:
Allium tolmiei (Tolmie's onion)	north and west
Ancistrocarphus filagineus (northern stylocline)	west
Angelica genuflexa (kneeling angelica)	east
Artemisia douglasiana (Douglas sagebrush)	south

Allium pleianthum

Range Extensions	Extended to the:
Atriplex confertifolia (sheepfat)	west
Betula glandulosa (bog birch)	east
Carex lasiocarpa var. *americana* (slender sedge)	south
Castilleja pruinosa (frosted paintbrush)	northeast
Cercocarpus ledifolius var. *intercedens* (mountain mahogany)	west
Comandra umbellata var. *californica* (bastard toadflax)	south
Cymopterus terebinthinus var. *foeniculaceus* (cymopterus)	west
Cynoglossum occidentale (western houndstooth)	north
Delphinium menziesii var. *pyramidale* (Menzies' larkspur)	east
Gaultheria shallon (salal)	east
Gentiana sceptrum (king's gentian)	east
Geranium bicknellii (Bicknell's geranium)	south
Geum triflorum var. *triflorum* (old man's whiskers)	west
Hackelia californica (California stickseed)	north
Hackelia diffusa (diffuse stickseed)	south
Hydrophyllum capitatum var. *alpinum* (wool-breeches)	north
Lathyrus rigidus (rigid peavine)	west
Lomatium leptocarpum (bicolor biscuitroot)	west
Lupinus bicolor (two-colored lupine)	south
Lupinus lepidus var. *lepidus* (prairie lupine)	west
Micropus californicus (slender cottonweed)	north
Petasites frigidus var. *palmatus* (sweet coltsfoot)	east
Phacelia thermalis (hotspring phacelia)	west
Physocarpus capitatus (Pacific ninebark)	east
Pinus lambertiana (sugar pine)	north
Plagiobothrys nothofulvus (rusty plagiobothrys)	east and south
Pyrrocoma carthamoides (Puget butterweed)	south and west
Quercus garryanna (Oregon white oak)	south
Ribes sangiuneum (red currant)	east
Sagittaria latifolia (wapato)	east
Satureja douglasii (yerba buena)	east
Senecio macounii (biennial stanleya)	north
Stephanomeria lactucina (large-flowered wirelettuce)	north
Valeriana occidentalis (western valerian)	west
Whipplea modesta (Yerba de Selva)	east

RICHARD ETTINGER

Collinsia grandiflora

Conclusion

This study started serendipitously when an opportunity for access onto the Reservation was granted by the Tribal Council. The many trips we made over the years were always interesting; some were very exciting. We formed many lasting friendships with the Indians and are honored by the recognition and respect they have shown us.

We feel this study has added significantly to the floral knowledge in Oregon, which is an objective endorsed by the Tribal Council. As there are no immediate threats to the floral populations on the Reservation, we believe it will maintain its stable native flora indefinitely.

Our intent has always been to give the information we acquired back to the Tribes. Hence, we have arranged to have the herbarium, photographs, and collection notes deposited at the Museum at Warm Springs. After David French's death in 1994, Kathrine French trusted us to mount his private

herbarium which, along with his notes, will also be deposited at the Museum. A complete collated floral checklist of the Plants of the Warm Springs Reservation of Oregon can be obtained from the authors.

Without exception, permission to travel onto Reservation lands for botanical studies must be obtained by application to the Tribal Council, Warm Springs Reservation, Warm Springs, Oregon.

RICHARD ETTINGER

Viola sheltonii

Acknowledgements

Judge Owen Panner provided the first stimulus for this research, providing support to approach the Tribal Council in 1979 for permission to study on the Reservation. Other important contributors and collaborators have been: Melvin Ashwill, Eric Brandt, Drs. David and Kathrine French, Dr. Michael Hammond, Richard Helliwell, George Schneiter, Scott Stuemke, Dr. David Wagner and his graduate students, Harvey Waldron, and valued members of the Warm Springs Reservation of Oregon Tribal Council throughout the years. A special thank you goes to tribal member, Prunie Williams.

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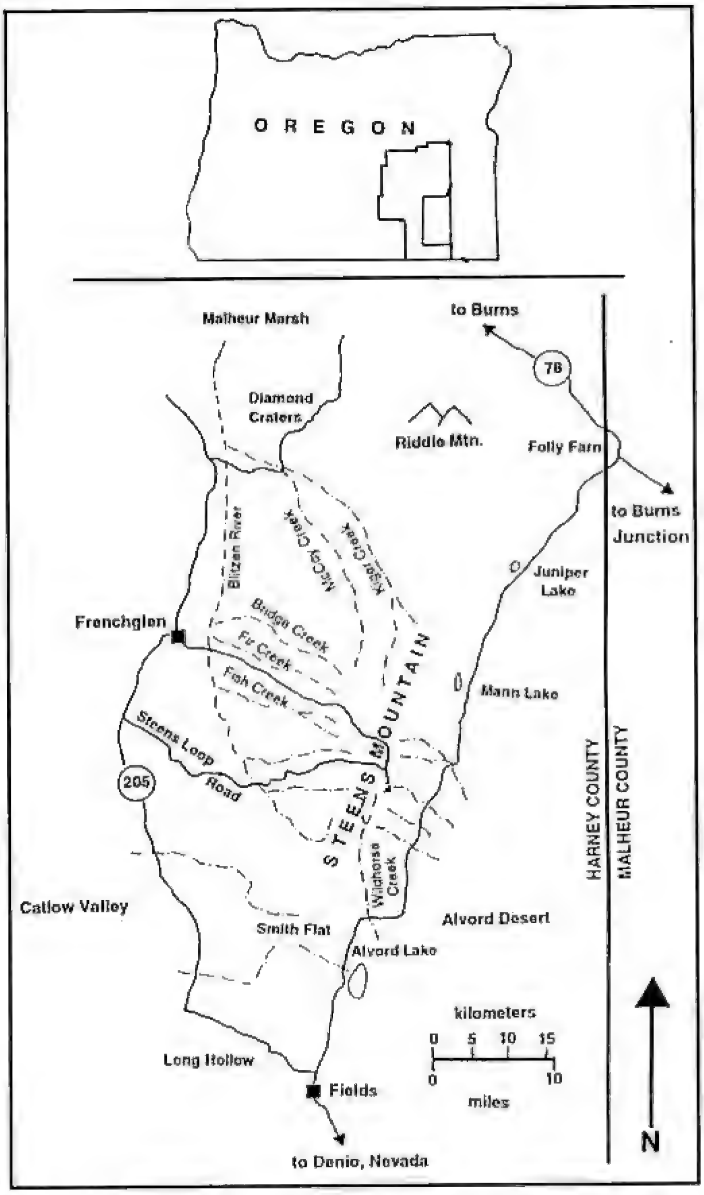
The Unique Botany of Steens Mountain: The Rare and Endemic Plants

By DONALD MANSFIELD

In southern Harney County the landscape rises from the west almost imperceptibly to nearly 10,000 ft. and the top of Steens Mountain. Without passing through even a hint of a forest, those traveling the Steens Loop Road soon find themselves among aspen groves, alpine meadows, cirques, and tarns. The vistas of glacial gorges and precipices dropping nearly 6,000 ft. to the Alvord desert rival any in Oregon. To the botanist, the excitement and intrigue is only beginning. From the desert scablands and riparian meadows and woodlands below to the alpine meadows, rock outcrops, and talus slopes of the "High Steens," wildflower displays abound at every turn. Plants abundant here are found nowhere else in the world. Many plants common in the mountains of California or Idaho can be found here as outliers, somehow lost from their relatives to the southwest or northeast, separated by miles of sagebrush desert.

Steens Mountain is the northern-most fault block mountain range in the Great Basin. When defined to include the mountainous area from Riddle Mountain on the north to the Smith Flat and Long Hollow region near Fields on the south, it occupies an area of approximately 1,000 square miles. The gorges on the west and north drain gradually into the Malheur Marsh and ultimately Harney Lake, while the steep eastern escarpment is drained by several streams that find their way to the Alvord Desert or Pueblo Valley. Southeastern Steens Mountain drains west into the Catlow Valley.

Steens Mountain is unusual physiographically in two respects. First, large basins, approximately 4,000 ft. in elevation, isolate Steens Mountain from other high mountain ranges. Strawberry Mountain in the Blue Mountains, 120 miles to the north, is the closest mountainous area rising above 9,000 ft. Second, Steens has extensive contiguous area (approximately 75 km^2) above 8,000 ft. elevation. The nearest ranges with this much alpine topography are the Cascade-Sierra Range 200 miles to the west and the Wallowa Range 200 miles to the northeast. The combination of isolation and extensive alpine topography results in a unique flora. This article will summarize some of the outstanding features of this unique botanical area and highlight its rare and endemic plant species.



Steens Mountain is located in southern Harney County, Oregon.

Geologic and Phytogeographic History of Steens Mountain

A brief geological history of Steens Mountain is relevant to understanding the unique qualities of the steens flora. The story begins about 30 million years ago during the Oligocene Epoch when the area was forested by a tropical flora. A widespread cooling trend ensued (Wolfe 1978) when the Cascade Range began to rise. By 20 to 25 million years ago (early Miocene) eastern Oregon was forested by a deciduous forest flora much like that in present-day Ohio or eastern China (Chaney 1956). Volcanic eruptions that occurred during this time produced the lowest rocks of what is now Steens Mountain — the red, principally rhyolitic and tuffaceous Pike Creek Volcanic Series (23 million years old). The Alvord Creek Formation of tuffs and plant fossil-bearing lake bed deposits formed approximately 21 million years ago in what appears today as the light-colored beds above Alvord Ranch. The Alvord Creek fossils tell us that annual precipitation at this time was about double the current rate and mean annual temperatures were higher and with less drastic extremes. (Wolfe 1978; Ferguson and Ferguson 1978). The andesitic and basaltic flows that today form the middle elevations of Steens (the Steens Mountain Volcanic Series) and the Steens Mountain Basalt that forms the present-day cliffs above 7,000 ft. flowed over the area from between 13 and 18 million years ago (mid Miocene). Roughly 8-10 million years ago (late Miocene) faulting began and the Steens uplift commenced. By this time,

the Sierra-Cascade Range had uplifted substantially, providing a rain shadow in southeastern Oregon (Fiero 1986). Together, these geological events resulted in a different regional climate and a greater diversity of habitats than had previously existed in the area. By about the end of the Miocene Epoch, the Great Basin floristic province had become established (Cronquist 1978).

By 2-3 million years ago (late Pliocene) the climate was generally cool and moist, though drier than in earlier times and with less summer precipitation. Consequently, the regional flora continued to change as new species emerged that were adapted to these new climatic conditions (Raven and Axelrod 1978; Cronquist 1978). The past few million years have been characterized by alternating glacial and interglacial periods. Three geologically distinct periods of glaciation are evident on Steens Mountain (Lund and Bentley 1976). Initially, glacial ice covered nearly 300 km^2 in the Fish Lake advance, filling or carving the major gorges — Big Indian, Little Blitzen, and Kiger. A second period (the Blitzen advance) was restricted to the canyons, covered about 130 km^2 and formed the headwalls of the major gorges. During the final and much smaller glacial advance that ended no later than 12,000 to 13,000 years ago (Thompson et al. 1986), the ice carved the smaller cirques that lie above 8,000 ft. including South Fork Willow Creek and Big Alvord. The past 8,000 years in the northern Great Basin have been characterized by a more xeric climate and a corresponding loss of mesic species from the region (Nowak et al. 1994). On Steens Mountain a roughly twofold increase in sagebrush to grass pollen is observed between 5,500 and 8,000 years ago, indicating that this period was the driest of the Holocene on Steens (Mehringer and Wigand 1985).

During alternating glacial and interglacial periods of the past few million years, two main processes appear to have produced the modern distribution of plant species in the Great Basin. First, during cool, moist periods of glacial advance, species migrated down in elevation (Thompson 1990) and/or into the region from the north (Cronquist 1978); during the warmer, drier interglacial periods species migrated to higher elevations and/or into the region from the south. Second, montane "islands" lost species via local extinctions and gained species by immigration according to the predictions of island biogeography theory (Wells 1983). Based on the current affinity of the flora with Columbia Plateau, Great Basin, and Sierra Nevada floristic elements (McLaughlin 1989), it appears that the present flora of Steens originated with the regional flora primarily during the Pliocene. That is, most of the plants of Steens Mountain are distributed throughout the northern Intermountain region. The unique aspects of the Steens flora, those features which distinguish it from the rest of the region, seem to result from the local extinction, migration, and speciation peculiarities during the geologically recent Quaternary Period.

Brief History of Botanical Exploration

The history of botanical exploration of Steens can be divided into three phases.

Early explorations: In the late 1800s, a few collections were made by William Cusick, John Leiberg, and others. In the early 1900s Morton Peck, Percy Train, Lila Leach, L.F. Henderson, and others briefly visited Steens. Of these, Percy Train's collections were the most extensive and unique, providing the only record of several of Steens plant species.

Expanding collections and classifying the unique flora: Through the mid-1900s collection trips, mainly from Western Oregon and New York Botanical Gardens by such individuals as Albert Steward, Arthur Cronquist, and Bassett Maguire, increased in frequency. At this time several systematists visited Steens to examine unique specimens discovered in earlier collecting forays. Until my recent survey, the most extensive botanical collection was done by Charles Hansen in the early 1950s as part of his doctoral studies on the vertebrates of Steens Mountain (Hansen 1956).

Continuing exploration through Malheur Field Station (MFS) and the BLM: Botany classes at MFS from the mid 1970s to mid 1980s, led separately by Karl Urban and Karl Holte, explored new areas of Steens and continued to contribute to new and unusual records. Collections by Dr. Urban, Dr. Holte, and their students occasionally provide the sole record of Steens' plant species. From the late 1970s through the early 1990s, BLM has contracted with botanists to survey various parts of Steens Mountain and the adjacent Alvord and Malheur basins. Since the late 1980s, I have been collecting extensively (independently, with students through MFS classes, and in cooperation with BLM) to describe the composition, distribution, and variation in the flora and document historical reports lacking vouchers. We now have an adequate sense of the distribution of several species on Steens and in the region and can begin to interpret the original, relationships, and uniqueness of the Steens Mountain flora.

The plant names used in this paper and in the Steens Flora attempt to follow the nomenclature being used in the Oregon Checklist project (Scott Sundberg, personal communication). The resources for identification of Steens taxa include, in roughly this order, the *Jepson Manual* (Hickman 1993), the *Intermountain Flora* (Barneby et al. 1990, Cronquist et al. 1972, Cronquist et al. 1977, Cronquist et al. 1984, Cronquist et al. 1994), the *Flora of North America*, volume 2 (Flora 1993), and the *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973). Distributional data are also derived from these same sources.

Steens Mountain Flora and Vegetation

At most recent count, the vascular flora of Steens Mountain is composed of 91 families, 381 genera, 1,115 species, and 1,179 subspecies or varieties. Of the 1,179 taxa, 86 (7.3%) are exotics (post-settlement introductions to the area), six are endemic to Steens Mountain or Steens and nearby ranges, and an additional 57 are currently listed in the Oregon Natural Heritage Program's Rare, Threatened and Endangered Plants and Animals or Oregon (ONHP 1993) — see Table 1). Steens Mountain represents well the estimated 4,400 plant taxa in Oregon (Scott Sundberg, personal communication). This diversity is largely attributed to the variety of habitats spanning its 6,000 ft. of relief.

To understand the distribution of rare plants on Steens Mountain, vegetation can be divided into three zones — the low desert (below 4,200 ft., or 4,600 ft. in the Catlow Valley),

montane (4,200 ft. to 8,200 ft.), and alpine (above 8,200 ft.). Within each of these broad vegetation zones exists a variety of habitats, each with a unique flora.

Expansive alkaline desert scrub habitats of the Harney Basin, Alvord Desert, and Catlow Valley below about 4,200 ft. to 4,600 ft. are dominated by greasewood *(Sarcobatus vermiculatus)*, spiny hopsage *(Grayia spinosa)*, shadscale *(Atriplex confertifolia)*, four-winged saltbrush *(Atriplex canescens)*, saltgrass *(Distichlis spicata* var. *stricta)*, and other halophytes (salt-tolerant plants). This bottomland scrub is designated "b" in Table 1. Better drained soils ("s" in Table 1) are dominated by such species as basin big sagebrush *(Artemisia tridentata* ssp. *tridentata)*, basin wild rye *(Leymus cinereus)*, or other non-halophytic species. Ash or sand ("a" in Table 1), barren clay soils ("c" in Table 1), and a variety of wetlands incuding riparian streamsides ("wr" in Table 1), ponds, lakes or marshes ("wp" in Table 1) are also evident throughout the basin deserts.

The lower flanks of Steens Mountain from about 4,200 ft. to roughly 5,500 ft. are dominated by big sagebrush *(Artemisia tridentata* ssp. *wyomingensis*, and *A. tridentata* ssp. *vaseyana)*, low sagebrush *(A. arbuscula)*, gray rabbitbrush *(Chrysothamnus nauseosus* var. *hololeucus)*, and a variety of forbs and grasses. These sagebrush-dominated slopes ("s" in Table 1) are quite prevalent. Between about 5,500 ft. and 6,500 ft., sage scrub is intermixed with the overstory dominant species, western juniper *(Juniperus occidentalis)*. Mountain mahogany *(Cercocarpus ledifolius* var. *intermontanus)*, bitterbrush *(Purshia tridentata)*, squaw currant *(Ribes cereum)*, and Lemon's needlegrass *(Achnatherum lemmonii)* often also dominate. Seasonally moist depressions and vernal pools ("wp" in Table 1), clay barrens ("c" in Table 1), riparian areas ("wr" in Table 1), and gorge-bottom woodlands and mesic north-facing forested slopes ("f" in Table 1) all contribute to the habitat diversity in the montane zone.

Aspen *(Populus tremuloides)* stands dominate sheltered and mesic sites of Steens Mountain between approximately 6,500 ft. and 7,500 ft. ("f" in Table 1). The more exposed and xeric sites between 6,500 ft. and 8,000 ft. ("s" in Table 1) are frequently dominated by mountain big sagebrush *(Artemisia tridentata* ssp. *vaseyana)* and a variety of forbs and grasses including orange sneezeweed *(Hymenoxys hoopesii)*, Steens Mountain thistle *(Cirsium peckii)*, squirreltail grass *(Elymus elymoides* ssp. *californicus)*, and Cusick's bluegrass *(Poa cusickii)*. In this upper montane area of Steens Mountain, meadows dominated by graminoids and perennial forbs ("m" in Table 1) are common. At these elevations in the Northern Rocky Mountains or on the east slope of the Cascades, one would expect to find forests of ponderosa pine and Douglas fir giving way to Engelmann spruce, or perhaps subalpine fir and occasional white bark pine or limber pine near timberline. None of these conifers are present on Steens Mountain. In this respect the "subalpine" zone of Steens Mountain is unique in Oregon. This absence of subalpine conifers is evident in several other Great Basin ranges but none as large as Steens. The remarkable absence of subalpine conifers is probably related to Steens isolation and possibly the biology of such seed dispersers as the Clark's nutcracker (Wells 1983). Hansen (1956) speculated that Native American use of fire permanently eradicated conifers that had been present historically. This interesting feature of Steens warrants future study.

Steens Mountain thistle *(Cirsium peckii)*

The highest elevations of Steens, above approximately 8,200 ft., lack the tundra character of most other ranges. The highest vegetation zone on Steens has been referred to as either "subalpine grassland" (Mairs 1977) or true alpine tundra (Collins 1978). Like other alpine areas in the western United States, the 'High Steens' lacks trees and receives high precipitation largely in the form of snow, which is irregularly distributed due to the wind. Furthermore, the area exhibits evidence of solifluction, the result of freeze/thaw cycles that move large quantities of soil (Bentley 1970, Collins 1978). Unlike true alpine areas, the "alpine" zone of Steens apparently lacks permafrost (Collins 1978) and permafrost-controlled vegetation, such as many common tundra cushion plants, like the ubiquitous moss campion *(Silene acaulis)*, that typify the alpine zone in the Sierra-Cascade or Rocky Mountains (Zwinger and Willard 1972). Like other Great Basin ranges (Barbour and Major 1977), the alpine vegetation of Steens Mountain is developed best in the wetter sites. Within this alpine belt, several vegetationally distinct habitats can be recognized. The dry, gravelly, windswept summit ridge and the lower lips of the cirques ("dg" in Table 1) come closest to the cushion plant-dominated "fell fields" of the Rocky Mountains. Alpine wet meadows and mesic meadows occur in cirques and pockets where snow accumulates and provides perennial water in the form of springs and a high water table ("m" in Table 1). Talus and scree slopes ("t" in Table 1), rock outcrops ("r" in Table 1), and riparian willow *(Salix* ssp.) -dominated areas ("wr" in Table 1) are evident on Steens as in other alpine areas. Gravelly solifluction zones adjacent to receding snowbanks ("wg" in Table 1) provide a final example of unique alpine habitat on Steens Mountain.

What Makes a Plant Rare?

A plant may be considered rare for one or a combination of the following reasons: 1) it covers a **small geographical range,** 2) it has very **specific habitat requirements,** and 3) it exists in **small populations** or sparsely distributed individuals (Rabinowitz 1981). Clearly, a species will be considered rare by anybody's definition if it has sparse individuals, requires limited and specific symbionts or soils, and is restricted to a small geograhical area. Furthermore, if such a species is threatened by any natural or anthropogenic environmental change (mining, recreation, invasion by exotic plants, etc.), it may be considered in danger of extinction. Conversely, if a plant exists in large populations with a large ecological amplitude, it may not be considered rare even if its geo-

graphical range is very small, especially if its population size is not changing in response to environmental changes. There are numerous permutations between these two extremes, so deciding whether a species is rare is not often a simple matter.

One of the most interesting types of rarity is based on limited geographical distribution. A taxon is endemic if it originated in and its distribution is limited to one area. A plant may be endemic to a large area (such as western North America) or to a small area (such as Steens Mountain). A species may be endemic for a variety of reasons that can be considered to span the range between the two extremes of paleoendemic and neoendemic (Kruckeberg and Rabinowitz 1985, Stebbins and Major 1965). Paleoendemics are relictual-remnants of taxa that were once more widespread. Neoendemics are newly formed taxa that may be in the process of expanding their range from their points of origin.

Steens Mountain draba
(Draba sphaeroides var. *cusickii)*

On Steens Mountain there are at least six endemic taxa (Table 1), all of which are evidently neoendemics for several reasons. All *(Agastache cusickii, Castilleja pilosa* var. *steenensis, Cirsium peckii, Draba sphaeroides* var. *cusickii, Penstemon davidsonii* var. *praeteritis,* and *Poa sp. nova)* are species or varieties with closely related counterparts in relatively close geographic proximity. For example, *Castilleja pilosa* var. *pilosa,* the ancestor of Steens' rarest and narrowest endemic *(C. pilosa* var. *steenensis),* is located below 7,000 ft. on Steens Mountain. All Steens Mountain endemics inhabit alpine rock outcrops or gravelly soils. This is an environment which is probably able to retain sufficient moisture during the driest period of the Holocene, yet, no doubt experienced extended periods of drought, imposing selective pressures that may have driven speciation. Three of these endemics *(Agastache cusickii, Cirsium peckii,* and *Penstemon davidsonii* var. *praeteritis)* have known populations in other Great Basin mountain ranges (Pueblos Mountains, ranges of northern Nevada, etc.) as well as on Steens Mountain. The fact that of these three, two are distinguished from their closest relatives at the species level and that all have populations outside of Steens Mountain suggests that their origins may be older and/or more geographically distant than the other three endemics.

If we are interested in a plant's rarity because we wish to maintain biological diversity, it matters how genetically diverse rare species' populations are and how genetically differentiated a rare species is from its close relatives. For example, two species with equally small population sizes, habitat requirements, and geographical ranges may not be considered equally "rare" genetically if one represents a small genetic variation (say, a subspecies or variety) from a widely ranging common species and the other represents a large genetic deviation (say, a different genus) from its most closely related species. From this perspective, one would surmise that the endemic plants of Steens Mountain do not provide the genetic diversity that paleoendemic genera (such as *Kalmiopsis* from the Siskiyou Mountains in southwestern Oregon or several of the California endemics) contribute.

For the past two decades Oregon has been developing a database of rare plants. Plants listed as rare, threatened, or endangered by the Oregon Natural Heritage Program (ONHP 1993) can be included for several reasons and those species that may have been considered appropriate to list in 1980 (in the list that predated the existence of the ONHP) or 1989 may not be listed in 1995. For example, some plants previously considered rare by criteria of small range or population size may no longer be considered rare as further populations are discovered and the species is seen to be more widely distributed. This is the case for several annuals found on Steens Mountain, such as *Dimersia howellii* or *Nemacladus rigidus.*

Rare Plants on Steens Mountain

The plant taxa found on Steens Mountain that the ONHP (1993) considered rare, threatened, or endangered are summarized in Table 1. Though Steens Mountain is a center of high plant species diversity, none of the vascular plant taxa of Steens is listed as either endangered or threatened at either the Federal or State level. Only 2 taxa *(Castilleja pilosa* var. *steenensis* and *Lupinus biddlei)* are candidates (C2 status) for consideration, meaning that they require "active protective measures to insure their survival" but that informaion on their biology and distribution is limited (ONHP 1993). The Steens paintbrush *(C. pilosa* var. *steenensis)* exists in several small populations along the summit ridge from the east Kiger rim to south Steens. Biddle's lupine *(L. biddlei)* is not a recognized taxon by the most recent treatment (Barneby 1990). It inhabits sagebrush-dominated sites in the lowlands.

Taxa on ONHP lists 2, 3 or 4 are either a) endemic but have sufficiently large populations to be considered not threatened with extinction or likely to become threatened under existing conditions (e.g. *Agastache cusickii, Draba sphaeroides* var. *cusickii, Penstemon davidsonii* var. *praeteritis,* or b) rare or well-distributed outside of Oregon but have limited population sizes or disjunct populations in Oregon.

Many Steens Mountain species (e.g. *Carex haydeniana, C. nova, Cymopterus nivalis, Llyodia serotina, Saxifraga adscendens, Sedum debile, Polemonium viscosum)* are widely distributed in the northern Rocky Mountains but are rare in Oregon. Others on Steens that are rare in Oregon are disjuncts from the Sierra Nevada flora (e.g. *Allium companulatum, Claytonia nevadensis, Salix orestera).* Fewer Steens plants with affinity to the flora of the Sierra Nevada are listed as rare (by ONHP) than plants with Rocky Mountain affinity because many taxa common to Steens and the Sierra Nevada are also found throughout the Southern Cascades and thus are not rare in Oregon. Other Steens taxa that are rare in Oregon are at the northern end

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Steens penstemon *(Penstemon davidsonii* var. *praeteritis)*

of their range in the Great Basin and may not be considered rare in Nevada, for example. These are typically low elevation taxa such as *Chenactis macrantha, C. stevoides, Caulanthus major* var. *nevadensis, Allenrolfea occidentalis, Phacelia gymnoclada,* and *Argemone munita* ssp. *rotundata* but also include a smaller number of taxa in the alpine such as *Ivesia baileyi* var. *beneolens* and *Cryptantha humilis.*

Several taxa on Steens are rare in Oregon because populations tend to be very small and sparse and/or the specific habitat required is rare even though the taxa may be more widely distributed in Oregon (e.g. *Botrychium lunaria, B. pinnatum, Gentiana prostrata, Gentianella tenella, Kobresia bellardii, Carex backii, C. praeceptorum, Allium madidum, Salix arctica).* Each of these has 3 or fewer known populations on Steens Mountain.

Perhaps the most distinctive plant of the Steens Mountain flora is the Steens Mountain thistle *(Cirsium peckii).* To the untrained eye, the plant appears to be the common, widespread (but allopatric) bull thistle of lower elevations. Steens Mountain thistle is not considered rare in Oregon despite its endemism to Steens Mountain because of its abundance and status in the area. The plant is a ruderal species — it thrives on disturbance in an otherwise moderate habitat (see Grimes 1979). Like a garden weed whose population increases after cultivation, Steens Mountain thistle proliferates along open disturbed roadsides, landslides, etc. throughout the montane zone. This is hardly the behavior one expects of a narrow endemic. However, for some reason related to Steens Mountain's isolation and the biology of the plant, the Steens Mountain thistle has not yet left the Steens-Pueblo range since its origin, probably in the late Pleistocene or Holocene.

A number of species on Steens Mountain are not considered rare in Oregon but they have limited distributions on Steens and are unusual in some respect that relates to Steens' unique botanical history and geography. For example, in 1992 I found bog wintergreen *(Pyrola asarifolia)* in the understory of the willows *(Salix planifolia* ssp. *planifolia* and *S. orestera)* of wet cirque bottoms. This plant is found in coniferous forests and shaded wetlands from California to Alaska and east through Canada. It is a "west slope" plant. The populations on Steens are therefore relicts from when cool, moist, closed-canopy wetlands were more continuously distributed from Steens Mountain to the Sierra-Cascade cordillera, possibly via the Wallowa Mountains. Several other taxa are rare on Steens but more abundant elsewhere in Oregon. *Saxifraga debilis* and *S. caespitosa* are found on wet, rimrock cliffs on Steens in only one or a few populations, respectively. Similarly, *Melica stricta* and *Pellea breweri* are rock crevice species that are rather rare on Steens but not regionally. Other Steens taxa, such as *Alopecurus genicalatus* and *Plagiobothrys hispidus,* are morphologically different than other Oregon specimens of the same species (even when observed in the alternating wet and dry years of the 1990s). In the case of the fir *(Abies)* on Steens (in small isolated populations in both Fir Creek and Moon Hill), there is disagreement about the genetic affinity of the taxon on Steens. Whether it is disjunct from the northern *Abies grandis* (Flora 1993) or disjunct from the Sierra Nevada *Abies concolor* var. *lowiana,* the Sierran white fir (Urban 1981), is unclear. This is the only conifer on Steens Mountain, other than western juniper and common juniper. It provides a good example of a relict population from the moist Pleistocene, but whether it is a relict of populations to the southwest or north remains to be determined.

Other taxa are not on the rare plant list because they are in taxonomically difficult groups that are still in the process of being analyzed. An undescribed bluegrass *(Poa sp. nova.)* occurs in the same wet gravels adjacent to receding snowbanks in which we find *Alopecurus geniculatus* and several other rare plants of Steens. This bluegrass has apparent affinity to several high elevation taxa in the *Poa cusickii* complex but seems to be undescribed and is currently under investigation by Robert Soreng (personal communication). Only one record of the blue willow *(Salix glauca* var. *villosa)* is known from Oregon. Having only recently been identified (George Argus, personal communication), this plant from Kiger gorge on Steens will soon be listed as one of the rarest in Oregon.

In light of the existing disjuncts and endemics, and the isolation of Steens, it would not be surprising to find some genetic differentiation among other species that may be obscure morphologically. At the present time, we know virtually nothing about the genetic variation between plant taxa on Steens Mountain and those of other ranges and can only base discussions of rarity on the morphological characteristics we see in herbarium specimens. Even as herbarium specimens are examined, we continue to find novelty in the Steens flora. Further systematic studies that include Steens specimens are warranted.

Synopsis

The alpine plants of Steens Mountain most characterize its unique botany (Table 2). Of the Steens massif, the zone above 8,200 ft. is smallest in area but has the largest number of rare taxa. Table 2 also illustrates that the areas most interesting botanically are the wet areas — wet and subirrigated meadows and wet gravels by receding snowbanks — and the rock outcrops. The alpine wet meadow species (e.g. the Botrychiums, gentians, and graminoids) are alpine disjuncts that were part of a flora shared by other ranges. These habitats on Steens contain several other alpine taxa (e.g. *Pedicularis attollens)* that are not rare and hence not considered here. These wet environments probably lost several species to local (and global?) extinction during the Holocene altithermal period (about 6,000 to 8,000 years ago on Steens Mountain). By monitoring species in these habitats we may have a good biological

indicator of the effects of global warming on the northern Great Basin.

At lower elevations, the botanically unique areas tend to be the drier sites (Table 2), such as ash bed, sandy soils, and clay depressions in the scablands. These habitats have probably also imposed selective pressures, which, combined with population fragmentation (due to the patchy nature of these environments), may have forced speciation throughout the Great Basin during the Pleistocene and Holocene, resulting in new, rare taxa.

At this juncture it is reasonable to ask: What are the effects of juniper encroachment (Miller 1994), grazing, and recreation on the rare flora of Steens Mountain? Few of the taxa listed in Table 1 are threatened by the juniper encroachment that is evident on Steens Mountain. Clearly, if encroachment progresses to the point of monotypic juniper stands, plant diversity is likely to decrease. Thus, from the perspective of maintaining rare plant habitat, a mosaic of diverse communities is desirable and juniper woodlands should be managed accordingly. Most of the alpine zone taxa are fairly secure with current grazing policies that, when enforced, prevent grazing above 8,000 ft. Many of the alpine meadow taxa may have been more widespread before sheep grazing ravaged Steens earlier this century, but this is conjecture. At lower elevations, however, grazing may be taking a toll on rare plants in riparian areas. For example, at least 3 low elevation riparian taxa (*Juncus capillaris*, *Juncus tiehmii*, and *Mimulus evanescens* [the latter is not listed in Table 1 because it was only recently described — Meinke 1995]) are known from Steens Mountain only by historical records. It is quite possible that, as Meinke suggested for *M. evanescens*, these taxa are rare and the Steens populations may have been decimated as a consequence of habitat destruction associated with grazing. Numerous wetland taxa (Table 1) are known from only one or a few populations on Steens (e.g. *Carex backii*, *Allium madidum*, *Downingia laeta*, *D. insignis*, *Myriophyullum sibiricum*, *Potamogeton diversifolius*, *Potamogeton filiformis*). These are indeed threatened by any activity that

Table 1. Rare Plants of Steens Mountain.

Taxa from Steens Mountain listed by the Oregon Natural Heritage Program are of general interest due to their rarity on Steens. ONHP (1993) list numbers (1 to 4) correspond to the list on which the taxon is currently found. Taxa on previous lists or dropped from consideration are also shown here (P). Endemics are denoted by '*'. The zones correspond to different alpine (A), montane (M), or desert (D) elevations as defined in the text. Different habitats discusses in the text are:

a—ash or sand
b—bottomland salt scrub
c—barren, clay soils
dg—dry, gravelly, windswept ridges
f—forested by aspen or riparian woodlands
m—wet or mesic meadows
r—rock outcrops and crevices
s—sagebrush-dominated slopes
t—talus or scree
wp—wetland ponds, pools, lakes, and marshes
wr—wetland stream side, riparian
wg—wet gravels

SPECIES	COMMON NAME	ONHP	ZONE	HABITAT
Aquatics, emergents, and vernal pool species				
Allenrolfea occidentalis	Iodine bush	2	D	wp
Downingia bacigalupii	Downingia	P	M	wp
Downingia insignis	Downingia	4	M	wp
Downingia laeta	Downingia	4	D	wp
Lilaea scilloides	Flowering quillwort	3	M	wp
Myriophyllum sibiricum	Water milfoil	3	M	wp
Potamogeton diversifolius	Diverse-leaved pondweed	2	M	wp
Potamogeton filiformis	Slender-leaved pondweed	3	D	wp
Rotala ramosior	Toothcup	3	D	wp
Ferns and fern allies				
Botrychium lunaria	Common moonwort	2	A	m
Botrychium pinnatum	Northwestern grapefern	2	A	m
Polystichum kruckebergii	Kruckeberg's holly fern	4	A	r
Polystichum lonchitis	Holly fern	P	A	r
Polystichum scopulinum	Rock sword fern	P	A	r
Pellaea brewerii	Brewer's cliff brake	P	M	r
Selaginella watsonii	Alpine spikemoss	4	A	r
Forbs				
Agastache cusickii	Cusick's horsemint	2*	A	t
Allium campanulatum	Sierra onion	4	M	s
Allium lemmonii	Lemmon's onion	4	M	c
Allium madidum	Swamp onion	4	M	m
Argemone munita* ssp. *rotundata	Prickley poppy	2	D	b
Astragalus alvordensis	Alvord milkvetch	4	D	a
Castilleja pilosa* var. *steenensis	Steens Mountain paintbrush	1*	A	dg
Caulanthus major* var. *nevadensis	Nevada jewelflower	2	M	t
Chaenactis macrantha	Mohave pincushion	2	D	a
Chaenactis stevoides	Desert pincushion	2	D	b
Cirsium peckii	Steens Mountain thistle	P*	M	s
Claytonia mevadensis	Sierran spring beauty	4	A	wg
Crepis modocensis	Modoc hawksbeard	3	M	s
Cryptantha humilis	Dwarf cryptanth	3	A	dg
Cymopterus nivalis	Hayden's cymopterus	2	A	r
Draba sphaeroides* var. *cusickii	Steens Mountain draba	4*	A	r
Ericameria discoidea	Discoid goldenweed	4	A	r
Eriogonum caespitosum* var. *hauschnecktii	Tufted buckwheat	P	A	dg
Fritillaria atropurpurea	Chocolate lily	P	M	f
Gentiana prostrata	Pigmy gentian	2	A	m
Gentianella tenella	Slender gentian	2	A	m

will disturb plant population processes, including grazing. Recreation can impose significant threats to rare plants (Losos 1995) but whether recreation threatens rare plants on Steens is largely unstudied. As with grazing in riparian areas, any disturbance to plant population processes can be problematic. Thousands of people now visit Steens annually, however, few travel to the sites inhabited by most rare plants. The Steens paintbrush is perhaps most threatened by recreation because its habitat is one most frequently visited. Because so many of the rare plants exist in only a few populations, it is imperative that all visitors, including botanists, **"tread lightly."**

DONALD MANSFIELD

Steens Mountain paintbrush (*Castilleja pilosa* var. *steenensis*)

What makes Steens Mountain interesting botanically, then, is the unique combination of Rocky Mountain and Sierra alpine and, to a lesser extent, montane plants. As a consequence of the isolation of Steens from these floras, to the northeast and southwest, respectively, some of the taxa have differentiated sufficiently to produce new species or varieties that are endemic to either Steens (e.g. *C. pilosa* var. *steenensis* and *D. sphaeroides* var. *cusickii*) or Steens and some combination of the surrounding ranges (e.g. *C. peckii* and *P. davidsonii* var. *praeteritis*). Other taxa simply remain as populations disjunct from the rest of their species to the northeast or southwest. Being at the northern limit of the Great Basin physiographic province also means that the Steens and surround-

Hackelia patens	Pale stickseed	3	M	s
Ivesia baileyi* var. *beneolens	Owyhee ivesia	P	A	r
Lupinus biddleyi	Biddle's lupine	3	D	s
Lloydia serotina	Alpine lily	3	A	m
Malacothrix glabrata	Desert dandelion	4	D	b
Malacothrix torreyii	Torrey's malacothrix	4	D	b
Orobanche pinorum	Pine broomrape	P	M	s
Pediocactus simpsonii* var. *robustior	Hedgehog cactus	4	D	s
Penstemon davidsonii* var. *praeteritis	Steens penstemon	4*	A	r
Penstemon janishiae	Janish's penstemon	3	D	c
Penstemon pratensis	Early penstemon	3	M	m
Penstemon seorsus	Short-lobed penstemon	3	M	s
Phacelia gymnoclada	Thick-leaved phacelia	2	D	a
Physaria chambersii	Double bladderpod	3	M	f
Polemonium viscosum	Sky pilot	4	A	r
Pyrola asarifolia	Bog wintergreen	—	A	wr
Pyrrocoma uniflora* var. *howellii	One-flowered goldenweed	4	A	dg
Saxifraga adscendens* var. *oregonensis	Wedge-leaf saxifrage	2	A	r
Saxifraga caespitosa* var. *minima	Tufted saxifrage	—	A	r
Sedum debile	Weakstemmed stonecrop	4	A	r
Graminoids				
Achnatherum speciosum	Desert needlegrass	2	D	s
Agrostis humilis	Alpine bentgrass	3	A	m
Alopecurus geniculatus	Water foxtail	—	A	wg
Carex backii	Back's sedge	3	M	wr
Carex haydeniana	Hayden's sedge	4	A	wg
Carex nova	New sedge	2	A	m
Carex praeceptorum	Teacher's sedge	3	A	m
Carex sheldonii	Sheldon's sedge	4	M	wr
Juncus bryoides	Moss rush	3	M	wp
Juncus capillaris	Thin rush	3	D	wr
Juncus hemiendytus* var. *abjectus	Center basin rush	3	M	wp
Juncus tiehmii	Tiehm's rush	3	D	wr
Kobresia bellardii	Kobresia	2	A	m
Melica stricta	Rock melic	—	A	r
Poa sp. nova.	undescribed bluegrass	—*	A	wg
Trees and shrubs				
Abies grandis	Grand fir	—	M	f
Populus augustifolia	Narrow-leaved cottonwood	4	M	wr
Salix arctica* var. *petraea	Arctic willow	P	A	m
Salix drummondiana	Drummond's willow	4	A	wr
Salix glauca* var. *villosa	Blue willow	—	A	wr
Salix orestera	Gray-leaved sierra willow	3	A	wr

Table 2. Distribution of rare plants on Steens Mountain.

The taxa from Table 1 are categorized by elevational distribution and by relative moisture regime or habitat.

	WETLAND	WET SOIL	VERNALLY MOIST	MESIC TO DRY	ROCK	**TOTAL**
Alpine	3	15	0	4	15	**37**
Montane	5	2	5	10	2	**24**
Desert	5	0	1	11	0	**17**

ing basins are the only Oregon home to several taxa more common to the south. This is particularly true of the desert flora. Though there are several alpine endemics as a consequence of this unique geographic position, the endemics are all fairly recent in origin owing to the relatively recent geological history of the area and the fairly radical climate change that the area has experienced during the Quaternary Period.

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The Changing Face Of Western Botany

By BARBARA ERTTER

Adapted from a talk at the Native Plant Society of Oregon Annual Banquet, 14 May 1994, in Ashland, Oregon; dedicated to John Thomas (Tom) Howell, 1904-1994. As general references on the following history of botany in the western United States, see McKelvey (1955), Keeney (1992), Reveal (1972), and Reveal and Pringle (1993).

Science does not occur in a vacuum, and the juxtaposition of philosophies and realities that shape the face of science undergo major shifts over extended periods of time. My original title, "The New Face of Western Botany," became "The Changing Face" when I realized that "Western Botany" has already gone through several "New Faces." The contemporary shift that first caught my attention is only the latest in a long series. Furthermore, the develoment of "Western Botany," intended to refer to the western United States, is rooted in the history of western civilization in general, beginning in Europe.

Folk Taxonomy And Classical Roots

In prehistoric Europe, as in the rest of the world, the first Face of Botany, the first knowledge of plants by humans, was not a specialized branch of learning belonging only to an elite (or eccentric) intelligentsia. Rather, every member of a pre-agricultural society depended on an intimate knowledge of the local flora, for food, medicine, and a diversity of other uses. Taxonomic and floristic information were part of the essential cultural heritage of a society, amassed and transmitted orally over the span of uncounted generations. For this transmission to occur, the components of the surrounding flora needed to be labeled. The folk taxonomies resulting from this preliterate naming of plants have been studied by ethnobotanists such as Brent Berlin (1992). Those of Greece and Rome in fact provide the core of our current taxonomic nomenclature, introduced into written history by Theophrastus, the "Father of Botany."

The works of Theophrastus and the equally esteemed early Roman authority Dioscorides suffered the same fate as did those of other classical sources during the Middle Ages, becoming allegorized for their putative Christian symbolism and enshrined as immutable, unchallengeable authorities. Also parallel to other disciplines, botanical knowledge expanded during the Renaissance. The development of the printing press played a significant role, in that the beautiful herbals that had previously been laboriously hand-copied could now be more widely available. As a result, it became increasingly evident that the 600 or so plants known to classical authorities were not in fact all that existed, as had once been believed.

Linnaean Names And Networks

Any final resistance to the heresy that different kinds of plants occurred in different parts of the world was washed away by the tidal wave of novelties arriving from distant shores. During the 250 years between Columbus and Linnaeus, the number of different plants known to European botanists increased to nearly 10,000. Linnaeus, like his contemporaries, tried to assign each of these plants a descriptive phrase in Latin (the universal tongue used by scholars throughout Europe). However, he also provided a single-word epithet for each species in a genus. Linnaeus himself considered the resultant binomial to be a trivial nickname, of little significance, but this "trivial name" is what caught on and earned Linnaeus his own descriptive phrase, "Father of Taxonomy."

Once his fame was established, Linnaeus seldom ventured far from home, depending instead on the steady stream of novelties collected by his disciples and correspondents from around the globe. This system of an institution-based expert providing a clearinghouse for a network of field-based contributors proved to be very effective. Plant exploration requires covering vast areas, generally far from population centers, but the analysis of the resultant collections requires the resources of a major herbarium, with abundant comparative material and library facilities. The initial cataloguing of the New World flora therefore occurred as a function of travelling collectors sending specimens to the great herbaria in Europe, where the type specimens of so many common American species are located as a result.

Establishment Of American Botany

In the decades following the American Revolution, resident botanists in the eastern United States gradually built up sufficient expertise and herbaria to declare botanical independence from European centers. The first center of American botany was, appropriately enough, Philadelphia, where American political independence had been declared.

Asa Gray

Courtesy Hunt Inst. of Botanical Documentation, Carnegie-Mellon Univ., Pittsburg, PA

The center shifted north in the early 1800's, triggered by the establishment by David Hosack of the Elgin Botanic Garden in New York, the first public garden in the United States. The garden itself failed (situated at the current site of Rockefeller Center, it was considered too far from New York City), but Hosack influenced Amos Eaton, a law student, to take up botany. In turn, "When he was jailed for his dealings in a troublesome land sale, Eaton taught the young son of the prison's fiscal agent his first lessons in the Linnaean method; the youngster was John Torrey" (Reveal & Pringle, 1993). Torrey *(Torreya)* ended up at Columbia College; he in turn inspired Asa Gray *(Grayia)*, who founded the

Gray Herbarium at Harvard University. Together, Torrey and Gray ("T. & G.") formed the clearinghouse and new voice of authority for American botany during much of the 19th century.

Early Exploration Of Western North America

Turning finally to western North America, the pattern of increasing autonomy is continued. We tend to forget how far the West Coast was from the centers of Western civilization during this period. The Panama Canal did not exist, so the entire coast of South America was more accessible to exploration than was western North America. Even Australia was better known, by virtue of its status as a British colony. Furthermore, the United States was only a minor player during this period, having just recently come into existence as an independent nation.

The earliest collections from western North America were therefore samplings taken along the Pacific coast by European exploring expeditions, who were primarily interested in seeking profitable trade items and unclaimed lands. The first species described from the West Coast was the sand verbena, *Abronia umbellata* (Nyctaginaceae), grown from seed sent to France from California in 1786 (the ill-fated Laperouse expedition itself subsequently perished in the South Pacific). Other expeditions nibbled the coastline, such as a British surveying expedition commanded by Captain George Vancouver *(Vancouveria)* in the 1790's, which included the Scottish naturalist-surgeon Archibald Menzies *(Menziesia, Pseudotsuga menziesii)*. The Russian presence during this period is evidenced by such eponyms as *Romanzoffia.*

Courtesy Hunt Inst. of Botanical Documentation, Carnegie-Mellon Univ., Pittsburg, PA.

Archibald Menzies

The only expedition from the United States during this early period was the one led by Meriwether Lewis *(Lewisia)* and William Clark *(Clarkia)* in 1805-1806, up the Missouri River and across the Continental Divide to the mouth of the Columbia River. The expedition was established by President Thomas Jefferson to survey the newly acquired Louisiana Territory (which Napoleon had sold in order to concentrate on European domination). By a complicated turn of events, the plants collected as part of the Lewis and Clark expedition were described not in Philadelphia, where the specimens are now housed, but in England.

The fledgling United States, however, was not in a position to follow up on any incipient claims to the West Coast, leaving the land battle to European claimants, particularly Spain, Russia, and Great Britain. The latter's presence in the region was primarily in the form of fur-trading enterprises; British trading posts on the Columbia River provided bases for British botanical explorers, generally in the company of fur trappers and other explorers.

Douglas And Nuttall

Undoubtedly the most significant of the botanical collectors during this period was David Douglas (Douglas-fir, *Douglasia)*, from Scotland. Douglas collected plants throughout the British territories of western North America in the 1820's and 1830's. As a British subject, Douglas had access to the resources of the Hudson's Bay Company, a distinct advantage unavailable to explorers of other nationalities. Douglas was part of William Jackson Hooker's network; his descriptions and names routinely appear in Lindley's *Botanical Register* ("Dougl. ex Lindl.").

Courtesy Hunt Inst. of Botanical Documentation, Carnegie-Mellon Univ., Pittsburg, PA.

David Douglas

Another particularly noteworthy collector during this early period was Thomas Nuttall ("Nutt.," *Cornus nuttallii)*, an Englishman working out of Philadelphia. In 1834, at the age of 48, Nuttall made the strenuous overland journey across the Rocky Mountains, in the company of Nathanial Wyeth *(Wyethia)*, a merchant from Boston who wanted to break into the lucrative fur-trading business (Wyeth built Fort Hall in what is now southern Idaho, but the venture failed when the British built Fort Boise in direct competition). While Nuttall described much of his own material, many names first appear in Torrey and Gray's *Flora of North America.*

The hazards and handicaps encountered beyond the frontiers by these early collectors were considerable, and not always appreciated by their institution-based collaborators. Douglas' relationship with his sponsor Hooker, for example, was often strained as a result. Keep in mind the limited transportation options, or the lack of medical treatment when constantly encountering grizzly bears, rattlesnakes, and other dangers. And how do you dry your collections after your boat has capsized, as happened to Nuttall? Consider also that you were likely to be trespassing into the territory of various Native Americans who might not welcome interlopers. The ameliorating factor was that the natives often treated foreign plant collectors with the same combination of respect and fear accorded to their own plant-collecting shamans and healers (or maybe just considered them "touched by spirits" and well worth leaving alone).

Thomas Nuttall

One Step Forward, One Step Back

The preceding and subsequent narratives may give the impression that knowledge of western botany increased in an unbroken lineage. Many of the events described certainly took place during a period when the American worldview was dominated by an unwavering faith in linear, ever-upward "Progress." As a counterpoint, however, it is important to remember that the actual First Face of Botany in western North America, as in Europe, was composed of the diverse folk taxonomies developed by the prehistoric colonists who came across the Bering Strait thousands of years earlier. In this regard, the Great Period of Exploration was actually a period of net *loss* of botanical knowledge, as the indigenous cultures were decimated and their accumulated knowledge lost.

Still, it is interesting to contemplate just what aspects of Native American folk taxonomies were transmitted to any European and American botanical explorers who took advantage of interacting with the original resident "botanists." At least a few indigenous names were adopted and latinized, such as "quamash" into *Camassia quamash*. Besides nomenclature, are there perhaps more subtle concepts that were also transmitted?

America Claims the West

After the Lewis and Clark expedition in 1805, several decades passed before the upstart United States again sent explorers to western North America. The ships of the United States Exploring Expedition, under the command of Charles Wilkes, arrived in 1841. The botanists, William Brackenridge and Charles Pickering, were able to make limited collecting trips inland, for the most part covering the same territory already gleaned by Douglas but nevertheless discovering some novelties, of which *Darlingtonia* is the most significant.

On the heels of the Wilkes expedition were three U.S.-sponsored overland expeditions in the 1840's. Numerous new species of plants were collected, among the first from the Great Basin. These were mostly described by Torrey, who had trained the leader of the expeditions, John Charles Fremont, in plant collecting techniques. Fremont *(Fremontodendron)*, one of the more colorful personalities in the history of the western United States, is better known to historians as an instrumental figure in the seizure of California from Mexico, eventually becoming a Senator and a Presidential candidate.

These expeditions mark the beginning of a major transition, intertwined with the United States' vision of Manifest Destiny. In fact, the driving force behind the aforementioned expeditions was probably less a spirit of scientific inquiry than a necessary precursor for expansionism. The discovery of gold in California (including some on Fremont's property) made an already swelling tide of immigration from the eastern United States unstoppable. By the time the dust settled, the United States spanned the continent, encompassing territory formerly claimed by Great Britain, Mexico, Spain, France, and Russia (as well as that of uncounted Native Americans).

The impact of American expansionism on western botany took several forms. For a start, the sporadic collecting of disputed or unclaimed territory before 1850 gave way to a New Face, that of major government-funded expeditions surveying newly annexed lands. In addition to military surveys of recently established borders, the need to keep the newly expanded nation united spurred a series of expeditions to survey potential railroad routes. Most surveys incorporated a botanical component, though a quote from McKelvey (1955) is of interest in this regard:

> "Although, over the years, the United States government had permitted plant collectors to accompany some of the expeditions which it has sent into the field, it had not approached the problem of scientific participation (botanical participation certainly) in what might be called a generous spirit. We have seen examples of this more than once. Men such as Gray and Torrey exerted pressure in Washington and, as a result, their fieldworkers were usually given military protection but scarcely more than that; even in 1849 Wright, accompanying an army contingent, was obliged to proceed on foot from San Antonio to El Paso." (p.674)

The Dissolution Of Gray's Hegemony

Another aspect of the New Face was that specimens flowed no longer primarily to Europe, but to respected botanists at established herbaria in the eastern United States. Asa Gray's influence grew as that of his mentor Torrey waned, and for nearly 30 years Gray's hegemony dominated American botany. This, however, was already giving way to yet another New Face by the time of Gray's retirement in 1873.

Gray's successor in his herbarium at Harvard was Sereno Watson ("Wats."), who had been a botanical collector on one of the great western expeditions, that of the U.S. Geological Survey of the 40th parallel across Nevada and Utah in 1867-74, led by Clarence King. Watson, "a shy man with a checkered past" (Reveal & Pringle, 1993), showed up in King's camp in Nevada, barefoot, age 42, looking for a place in the expedition. He started as camp cook, but eventually replaced the botanist, William Bailey *(Ivesia baileyi)*, who became ill (Goodale, 1893). After becoming Gray's assistant, Watson described much of the new material still flowing from the West, but he was unable to continue Gray's hegemony in the face of increasing decentralization.

Competition came from several directions. The National Herbarium, initiated with the collections from the Wilkes

expedition, had first claim to specimens collected by subsequent government-funded expeditions. As a result, several western state floras were published as *Contributions from the National Herbarium*, e.g., Washington (Piper, 1906) and Utah and Nevada (Tidestrom, 1925). The upstart New York Botanical Garden acquired Torrey's herbarium and library in 1899, claiming Torrey's former mantle with them. The Missouri Botanical Garden, founded by Henry Shaw in 1859, was ideally situated at the confluence of the Missouri and Mississippi rivers to dominate the center of the country, an opportunity well taken advantage of by botanist George Engelmann *(Picea engelmanni)*.

The West Gains Autonomy

The most significant break from Gray's hegemony, however, came from the west itself, where the population had grown to the point of supporting resident botanists. Whilst the great eastern institutions jostled to divvy up North America among themselves, autonomous centers began to develop west of the Great Plains. As early as 1853 the California Academy of Sciences was established in San Francisco by a group of gentlemen physician-scientists, with Albert Kellogg *(Kelloggia, Quercus kelloggii)* as primary botanist. Unfortunately, the herbarium, except for types, was destroyed in the fire following the Great San Francisco Earthquake of 1906. By coincidence, this was the same year that Louis Henderson's herbarium at the University of Idaho was likewise destroyed by fire.

The break from eastern domination was furthered when Aven Nelson ("Nels.") started the Rocky Mountain Herbarium at the University of Wyoming in 1894. In 1880 the Young Naturalists Society of Seattle founded the herbarium that would eventually find a home in the University of Washington. Albert R. Sweetser established the University of Oregon Herbarium in 1903. Other herbaria began to spring up across the country, variously allied to or independent from existing botanical centers.

The Rise Of "The New Botany"

On a broader front, the Morrill Act of 1862 created the great system of land-grant colleges. Botany was a required subject, thereby creating a great market for aspiring botanists in the late 1800's. Land-grant colleges provided a bigger challenge than just a multitude of competing herbaria, however, in the form of academic "professionalization." At the forefront of the professionalization of botany was Charles E. Bessey *(Besseya)*, a professor of botany at Iowa and Nebraska. Bessey championed "the New Botany," with the goal of creating a true science of botany, characterized by explicitly objective and experimental methodologies comparable to those being developed in other scientific disciplines. Within academia, the field blossomed as a result; where botany had once been synonymous with plant collection and classification, it now expanded to include what would become the subdisciplines of plant anatomy, physiology, genetics, and ecology.

The impact of "the New Botany" on taxonomy itself was the creation of the subdiscipline of systematics. In the broad sense, systematics can be divided into three subdivisions: basic taxonomy, phylogenetic relationships, and evolutionary processes (Stuessy, 1990). A primary result of efforts to make systematics more "scientific" was a shift of emphasis away from taxonomy, which was considered "merely descriptive," to the more overtly experimental subdivisions of phylogenetics and evolutionary processes. To a certain extent, this can be seen as a rebellion against the authoritative, apparently subjective, undefined methodologies in place at the turn of the century, especially when espoused by mainstream contenders fighting against or striving to reclaim Gray's hegemony.

As a result, the Academic Face of Botany has taken the form of an on-going quest for ever-more sophisticated experimental techniques offering increased precision, rigorousness, and objectivity. The first major step in this direction was actually pioneered in the West, in California, where the seminal experiments in biosystematics were carried out by Jens Clausen, William Heisey, and David Keck (1940). Cytogenetics followed, and then chemotaxonomy. Computers triggered the development of phenetics and cladistics, both pre-adapted to handle the wealth of point-data now being generated by a diversity of molecular sequencing techniques.

An Example From California

The University of California at Berkeley is used to illustrate the develoment of this Academic Face of Botany (Constance, 1978), with similar chronologies occurring elsewhere in the West. Edward Lee Greene was the first projessor of botany at the University of California following its establishment at Berkeley in 1868. Greene, eight years younger than Watson and 24 years younger than Gray, was at the forefront of dissidents against Gray's hegemony and eastern domination of western botany.

Courtesy Hunt Inst. of Botanical Documentation, Carnegie-Mellon Univ., Pittsburg, PA

Edward Lee Greene

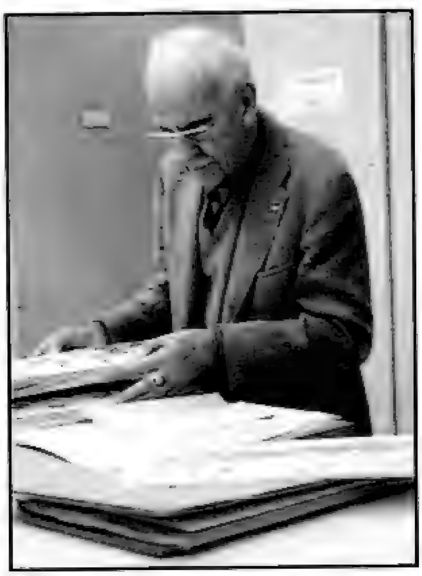
It is hard for us to appreciate the limitations under which Greene and his western contemporaries were working. Only a rudimentary library, essentially no access to type specimens of previously described species, and few other specimens other than the ones he collected himself. Greene was also operating within a very different philosophy and set of standards than are now considered the norm; for one thing, he was an avowed Creationist. He also adopted a "splitter's" strategy; when in doubt, emphasize the differences. In spite of this, McVaugh (1983) has calculated that 70 percent of the taxa described by Greene have withstood the test of time.

Green was nevertheless a primary example of the arrogant, authoritative, "it's a species because I say it is" approach to taxonomy that practically begged to be attacked, thereby in part triggering the development of "the New Botany." Ironically, Bessey, as a visiting lecturer of botany, actually antedated Greene at Berkeley.

When Greene accepted a position at Catholic University (taking his herbarium with him, which eventually ended up at Notre Dame), he was succeeded by his first student, Willis Linn Jepson (*Jepsonia*), who continued as Professor of Botany at Berkeley for over 40 years. Jepson himself represented a New Face of Western Botany, in that he was a native Westerner, with a native's love of the region extending well beyond mere professional interest.

In conjunction with his floristic focus, Jepson claimed hegemony over California, established Berkeley as a clearinghouse, and developed a network of contributors and collaborators. At the same time, however, he incorporated some of the principles of "the New Botany" into basic taxonomy, resulting in the development of the monographic style of floristic writing which is the current standard, in contrast to previous floras which were generally little more than annotated checklists. Furthermore, he emphasized plants as organisms within specific physical and biotic environments, rather than as isolated specimens (Constance, 1974).

A balance between basic taxonomy and "the New Botany" flourished at Berkeley among the students of Jepson and his successor, Lincoln Constance (*Cardamine constancei*, "Math. & Const."). A native of Eugene, Constance was a protege of Louis F. Henderson at the University of Oregon and subsequently a student of Jepson. Under Constance's guidance, the Academic Face of Botany at Berkeley took the form of in-depth monographic studies incorporating the latest experimental techniques, primarily biosystematics and cytogenetics.



BARBARA ERTTER

Lincoln Constance

The Decline Of Taxonomy In Academia

As was the case with general botanical knowledge during the Great Period of Exploration, it would be an oversimplification to present "the New Botany" as unmitigated linear progress. The wheel that Bessey set in motion did not stop, but began to erode the status of basic taxonomy as a legitimate academic pursuit. In the West, as elsewhere, recruitments for faculty openings in plant systematics now concentrate on expertise in computer-assisted phylogenetic analyses incorporating data from molecular sequencing, de-emphasizing floristic and basic taxonomic knowledge.

The operating assumption, that "the New Systematics" addresses everything covered by "the Old Taxonomy," has not held up. This is not because the current crop of academically successful systematists is incapable of or uninterested in basic taxonomy; often quite the opposite! But the priorities of modern systematics put a limit on how much time and resources can be devoted to time-consuming activities fundamental to basic taxonomy: botanical exploration, specimen collecting and identification, learning the local flora, and annotating herbarium specimens. New species descriptions are considered to be minor contributions, even though these represent the foundation for all other botanical knowledge. Floras are deemed unsuitable for doctoral work in systematics, and even monographs may be counterproductive in an academic environment that is geared to multiple small papers per year. Such is the Current Face of Academic Botany.

If basic taxonmy were obsolete, then its potential disappearance from mainstream academia would be a non-problem. Instead, the need for the products of basic taxonomy is at an all-time high, as the source of answers to fundamental questions involving biodiversity, extinction, and conservation biology. How, after all, can we take measures to conserve species that have not yet been discovered and studied? How do we know which ones are rare if their ranges have not been determined? How can inventories be done without up-to-date floras and monographs with which to identify the specimens? And who will provide determinations for problematic specimens if taxonomic specialists are not replaced in kind?

Who, then, is doing basic taxonomy, who is writing the floras, discovering the new species, carrying out the inventories, and identifying the specimens, if these activities are no longer considered proper activities for the Academic Face of Botany? The answer is that academia is only one facet of the "Changing Face of Botany" theme, and it is outside of mainstream academic systematics that basic taxonomy is not only alive, but flourishing.

The Professionalization Of Botany

The seeds for the develoment of this alternte Face of Western Botany beyond academia are well described by Keeney (1992) in *The Botanizers:*

> "Until the late 1870s American botanists, professional and amateur alike, were overwhelmingly dedicated to taxonomy... When, in the fourth quarter of the nineteenth century, the vast majority of professionals turned from natural history to biology, amateurs found that natural history, which at first had aligned them with the mainstream of professionals, now separated them from it..." (p. 148)

> "Unlike field botany, the New Botany required specialized training and equipment, making it inaccessible to many amateurs. Professionals used the New Botany to institutionalize and to develop professional autonomy...

Professionals perceived the new approach as giving botany 'greater scientific authority,' which in part meant that it placed the science firmly in the grasp of professionals. Only professionals had the expertise to execute the New Botany, and certainly only they could judge it." (p. 128)

"This was not simply a case of professionals cutting amateurs out of the action: amateurs generally found the New Botany unappealing... Seen through the eyes of professionals, amateur botany had failed to adjust to professionalization and the modernization of botany. The view from the botanizers' perspective tells a different story... Botanizing met the twentieth century on its own terms as a thriving hobby outside the view of science." (pp. 133-134)

How well does the rift between professionals and amateurs described in *The Botanizers* describe a Face of Western Botany? In general, most of botany (or plant sciences, the term preferred by non-taxonomists) has indeed securely become the province of professional academia, and much of systematics has followed suit. Articles such as "A chloroplast DNA phylogeny of the Caryophyllales based on structural and inverted repeat restriction site variation" [Syst. Bot. 19:235] are generally of little interest to the uninitiated. Simultaneously, botanizing had indeed flourished outside of academia, in the form of numerous native plant societies and conservation organizations. The Native Plant Society of Oregon is an excellent example, as are the Heritage programs established in various state departments by The Nature Conservancy.

At least in the West, however, the schism is neither as well-defined nor the situation as straight-forward as described in *The Botanizers*. The readership of *Kalmiopsis* is vivid proof of that, including individuals who are both academic botanists *and* active members of the Native Plant Society of Oregon. The key lies in two additional Faces of Western Botany in the 20th Century. First, the flora of western North America was far from being fully explored at the time that "the New Botany" was being promoted. Second, "professional" and "academic" are no longer synonymous, and the growing number of professional botanists outside of academia are an increasingly significant Face of Botany in their own right.

The Search Continues

One factor potentially contributing to the shift away from basic taxonomy is the fact that Charles Bessey and many other champions of "the New Botany" were situated in the Midwest, where the taxonomy had already been pretty well worked out. Bessey himself spent much of his career in Iowa, where the tongue-in-cheek "Key to the Flora of Iowa" supposedly goes: "Plants green — corn. If not corn, you're not in Iowa."

Be that as it may, basic plant taxonomy has remained a fruitful field in the western United States, as noted by Constance (1964):

"Many otherwise informed persons assume that the exploratory phase of botany is essentially complete; this assumption is, of course, an entirely erroneous one."

While the truth of this statement is generally accepted for the distant tropics, its relevance to western botany is less well appreciated. Nevertheless, as calculated by Shevock and Taylor (1987; updated by Taylor, pers. comm.), an average of ten new plants per year have been described from California for the last several decades; a similar trend could probably be calculated for Oregon and other western states. As a result, for most of this century, exploratory taxonomy and floristic studies have continued to play a prominent role in western botany alongside the flourishing of "the New Botany."

The Heirs Of The Botanizers

Increasingly, however, the exploratory taxonomy and floristic studies have been done not by the professionals in academia, but by the heirs of the botanizers. Jepson cultivated some of these botanizers as part of his network, as did curators at herbaria elsewhere in the West. California Academy of Sciences in particular provided a fertile ground for the continued taxonomic contributions of amateurs. An incipient tradition was brought to fruition by Alice Eastwood, grand dame of botany at the Academy during the first half of this century. Under her guidance, devoted amateurs comprising the California Botany Club learned the local flora, brought in specimens from around the state, and provided a support group for herbarium curation.

Courtesy Hunt Inst. of Botanical Documentation, Carnegie-Mellon Univ., Pittsburg, PA.

Alice Eastwood

What Eastwood began, her assistant John Thomas Howell energetically continued. Following a model established by Howell, most of the county floras that have appeared in California during the last half century have been compiled by members of the Club. Even during this last decade, when Howell's health prevented much attention to his own research, he continued to provide inspiration for the California Botany club. Among other collaborative projects involving amateurs spearheaded by Howell was "Base Camp Botany," a series of collecting trips to the High Sierra under the aegis of the Sierra Club. The last trips in this series were overseen by Peter Raven, who first came under the tutelage of Eastwood and Howell at the tender age of nine (Raven,1995), and who subsequently, as Director of the Missouri Botanical Garden, has become one of botany's leading spokesmen.

The heirs of the botanizers include more than talented amateurs and incipient academic botanists, however, an increasingly significant Face of Western Botany is that of the non-academic professional. This Face has resulted at least in part because nature-study did not remain merely a hobby, but instead provided one of the nuclei from which the environmental movement arose. As a result, there are now more botanists in the western United States working for various federal and state government agencies than there are in academic positions. Nor should one overlook the increasing number of botanists employed by the private sector, primarily environmental consulting firms. As one consequence, new plant species in the West are now as likely, perhaps more likely, to be described by agency botanists, environmental consultants, horticulturalists, and native plant enthusiasts as by academic botanists.

The *Jepson Manual* Example

Even within academia the dichotomy between "professional" and "botanizer" is not clear-cut, such that much of the basic taxonomy still being done under the aegis of academia has personal satisfaction rather than professional advancement as a reward. Take, for example, one of the most recent floristic efforts, the new *Jepson Manual* (Hickman, 1993). For background, the terms of Jepson's endowment to the University of California stipulated that his original manual (Jepson, 1925) be updated, and his multi-volume *Flora of California* be completed. For the reasons previously discussed, the activities necessary to meet these terms were not compatible with professional advancement, so neither *Manual* nor *Flora* were priority items for endowment-funded curators.

Only when the previous curator, Lawrence R. Heckard (a Washington native who majored in horticulture at Oregon State University prior to pursuing doctoral studies with Constance at Berkeley), took a cut in his own salary to provide seed money for funding-raising efforts, was the new *Jepson Manual* project initiated. The project was subsequently spearheaded by James C. Hickman, whose doctoral work at the University of Oregon had focused on plant ecology and taxonomy in the Cascades. Mainstream funding (i.e., from the National Science Foundation) was obtained only at the tail-end of the project; most funding came from a diversity of altenate sources.

Furthermore, funding primarily provided only for the infrastructure, the editing and coordinating of the output of the nearly 200 unpaid contributors who provided the bulk of the actual text. As a rough calculation, only about half of the contributors were faculty or research staff at colleges and museums, and this is including retirees, non-systematists, and faculty at colleges too small to have a decent herbarium. The remainder consisted of non-academic staff, consultants, agency botanists, students, and other miscellaneous contributors, all of whom prepared treatments in their spare time (as, for that matter, did many of the faculty and research staff). This is the same pool on which other floristic projects currently depend, including the Oregon Flora Project.

Separating The Tool From The Trade

On the one hand, this way of doing floras provides a wonderful outlet for a diversity of taxonomically talented individuals outside of the academic systematic mainstream. On the other hand, it illustrates a system that depends on a fragile network that contains some potentially weak links. One obvious weak link is the heavy reliance on emeriti, retired professors from the monographic era who are not being replaced in kind. No incipient umbel expert is in line to replace Lincoln Constance, for example.

Another problem is that active taxonomists are being separated from the primary tool for doing taxonomy, the herbarium. In a very real sense a major herbarium, with associated library, is a fully equipped laboratory for doing basic taxonomic and floristic research. Howeve, the best university-based herbaria are generally at the same institutions that are the forefront of "the New Systematics," while the small colleges that could otherwise provide a refuge for basic taxonomy generally have limited herbaria and library facilities, in addition to restricted research opportunities. This situation is exacerbated when major herbaria are combined, as happened with the recent transfer of the University of Oregon herbarium to Oregon State Universtiy. As a result, botanists in the Eugene area must now travel to Corvallis in order to undertake critical taxonomic research.

This separation of tool and research occurs even within an institution, where activites that were formerly considered the province of taxonomists are now often fragmented among departments of geography, ecology, and resource management. The herbaria, meanwhile, remain with the mainstream systematists, even when they are primarily involved in laboratory-intensive research and have limited curatorial interest or experience. is it any wonder that herbaria are having trouble justifying their continued existence?

The Developing New Face Of Western Botany

In spite of these and other difficulties, I find room to hope. Taxonomy is not dead; on the contrary, it is alive and well, but *outside* of mainstream academic systematics, among the heirs of the botanizers. In fact, I have come to believe that we are in the midst of developing a New Face of Western Botany, a change as fundamental as that triggered by "the New Botany," that of a collaborative partnership between academia, non-academic professionals, and dedicated amateurs. Many NPSO members are already involved in this kind of collaboration, such as for the Oregon Flora project.

A prime example of the partnership in action isprovided by the Shasta snow-wreath, *Neviusia cliftonii* (Rosaceae). The discovery and publication involved two botanical consultants, a forest service botanist, and a university-based taxonomist in a non-research position. A year after the discovery, the word was spread that anyone wanting to assist in the search for new populations should congregate at a group campground that had been reserved by the local forest service botanist, former Oregonian Julie Kierstead Nelson. The forest service also provided a boat to ferry some participants across Shasta Lake.

Nearly 50 botanists showed up, mostly agency botanists and consultants on their own time. As a result, five more populations were found, bringing the total currently known to eight (Shevock, 1993). Several particiants were from Oregon, who hoped next to search for outlying populations in the limestones of southwestern Oregon.

This kind of project provides a model for future programs, particularly those related to major biological inventory efforts as originally envisioned under the National Biological Service. To bring the necessary partnership to full fruition, however, the dispersed pieces of taxonomy need to be tied together, with a sharing of resources, a free flow of information, and a coordination of efforts. To accomplish this, we first need to realistically determine where the necessary expertise and resources are, both within and outside of academia. the next step is to strengthen the weak links and compensate for any missing pieces. Finally, the components need to be woven together into a mutually rewarding system. The challenge is daunting, but invigorating, and we all have a part to play in the Ever-Changing Face of Western Botany.

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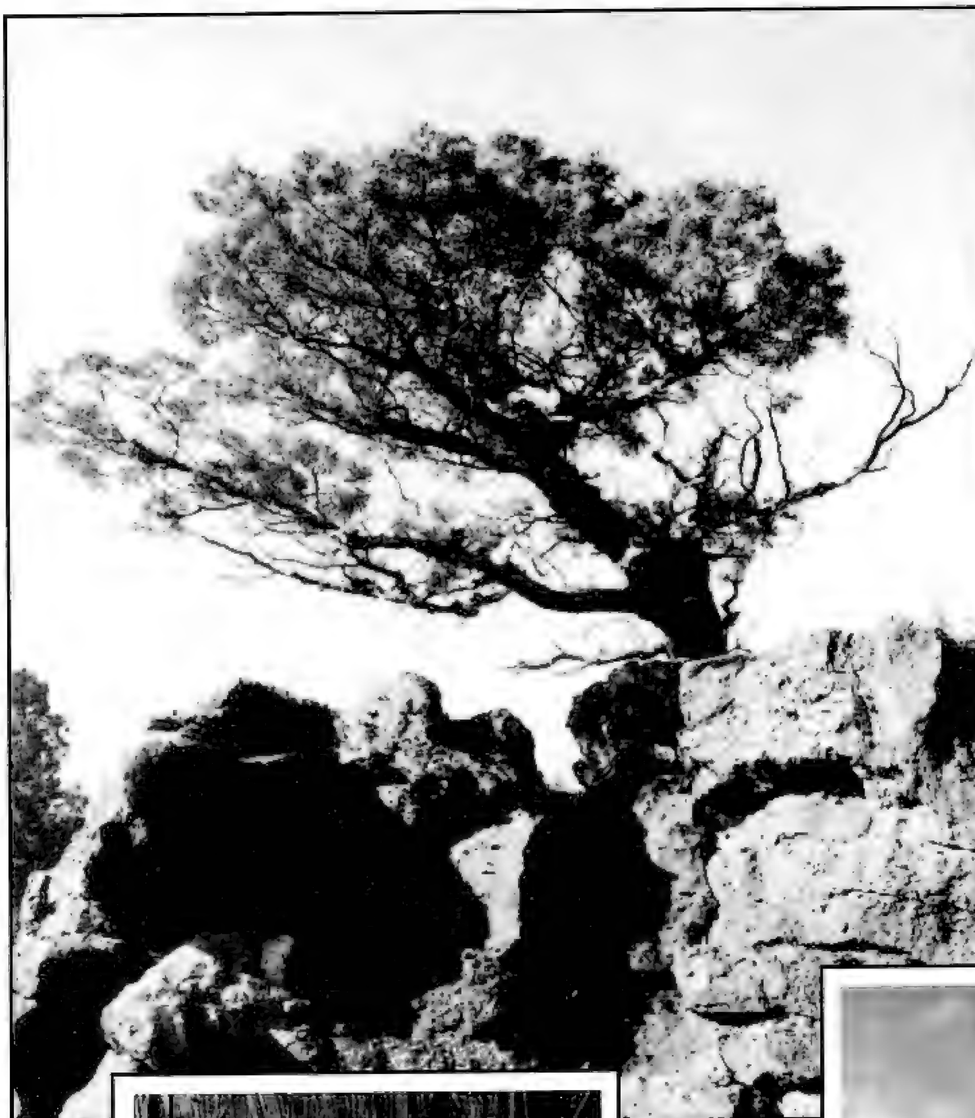
STU GARRETT



STU GARRETT

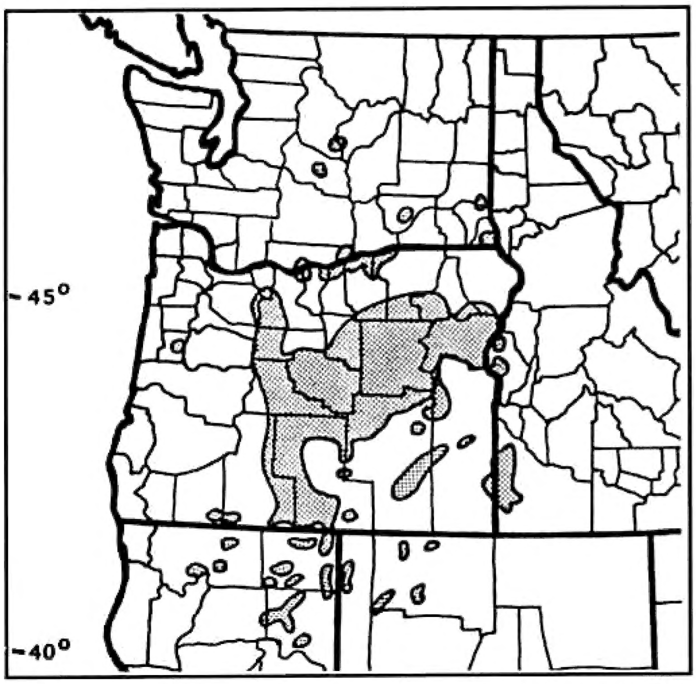
STEVE GOOD

STEVE GOOD

The Western Juniper

By STUART GARRETT

No tree is more evocative of Oregon east of the Cascades than the juniper. While our pines are found throughout the West, the heart of the worldwide range of western juniper is in Central and Eastern Oregon. Those gnarled and ancient trees growing straight out of lava leave an indelible impression on anyone who has ever experienced an Oregon high desert sunset.



Generalized distribution of western juniper (shaded portion). Tree densities vary among and within the different localities.

Biology

The western juniper (*Juniperus occidentalis Hook.*) is not usually a large tree. It is frequently under 30 feet tall but is rarely over 70 feet high. It tolerates a variety of soils and substrates. The species is either dioecious or monoecious. it sends out sprays of pollen in March which is extremely allergenic to some people. It has attractive grayish blue seeds that stay on the tree for two years. The seeds are a favorite of birds of the thrush family. Townsend's solitaires apparently survive primarily on these seeds through part of the winter. Passage through the gut of a bird scarifies the seed coat so that it more readily germinates. Many young junipers are found growing in a sagebrush where a perching bird has deposited a seed. In central Oregon many rows of junipers line roadways. These trees were deposited by birds perching on fences, not planted, as many people assume!

The juniper is important for other animals. Maser lists over 70 species that use juniper in some fashion. Cavity nesters make use of the long lasting stumps. The trees provide cover and shade and food for other species including mammals such as deer, elk, etc. Bats hide in them. Indians used the juniper wood for bows, firewood, and shelter. The bark made sturdy baskets. Ranchers utilize the trees for long lasting fence posts.

Juniper engages in chemical warfare; the alleopathic chemicals in its foliage which inhibit the germination and growth of juniper seeds and other plants. The several pests of juniper include two mistletoes, two rusts, a wood borer, and a rot.

Management

Juniper is on the increase in Oregon in a number of areas. Old photos document this well. At least three reasons are offered for this change. One has to do with fire suppression. Young junipers are very susceptible to fire. Their bark is thin. Many older trees stand on rocky ridges where fire frequencies are low. The Euro-American suppression of fire over the last 100 years has generally favored juniper increase. Another reason for juniper increase is livestock grazing. Cattle tend to prefer grasses and removal of grass competition favors woody species. Removal of fine fuels (grasses) also decreases the fire frequency, which favors juniper. Finally, Dr. Pete Mehringer at Washington State University has shown through pollen counts in core samples from Steens Mountain, Oregon, that changes in climate cause junipers to increase or decrease in significant amounts. Perhaps our weather is changing to favor juniper.

In any event, agencies and landowners are striving to control juniper. Cutting and burning of these trees is increasing. Studies have shown that on a given piece of land, cattle forage can be increased by up to 300 percent by controlling juniper. This is a strong economic incentive for ranchers. Some environmental groups feel that juniper control is being overdone. Economic uses of the trees are being sought. The best one that I've seen is for beautiful rustic furniture being produced in Prineville and Burns.

Closed juniper canopies eliminate most other plants. This leaves nearly bare soil which is more erodable, reduces water infiltration, and promotes the invasion of exotic species such as cheatgrass. This is particularly devastating in overgrazed areas. Studies show that a medium sized juniper control can increase streamflow in a basin. Percolation and infiltration of precipitation is also hindered. Rain or snow falling on juniper branches is more likely to evaporate in our dry climate before it reaches the ground.

The juniper is a complicated and interesting denizen of Oregon's high desert. Maligned by many and admired by few, this is a remarkable tree.

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— Native Plant Society of Oregon —

Dedicated to the enjoyment, conservation, and study of Oregon's native vegetation.

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